

INSECTS OF ECONOMIC IMPORTANCE

HERRICK



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CARPENTER & CO.
ITHACA, NEW YORK

Insects of Economic Importance

Outlines of Lectures in Economic Entomology

BY

GLENN W. HERRICK,

Professor of Economic Entomology, Cornell University

ITHACA, N. Y.:
CARPENTER & COMPANY

1915

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PREFACE

Not all insects of economic importance are included in these outlines. To discuss them all, a book of many times the size of this would be needed. However, the principal pests of our main fruits, vegetables, cereals, farm animals, shade-trees, and of the household are discussed. A brief summary of the life habits of each, so far as they are known, is made, and the latest methods of control are outlined. In addition, a concise discussion of insecticides is given together with formulae and directions for making and applying them.

Finally, references are given to the more important sources of information regarding the insects and their control. As far as possible, references are made to bulletins available to the general student and to those publications giving good illustrations of the insects, together with the most approved methods of control. It is neither possible nor desirable to give references to all the literature on any one insect pest but additional references to the later literature as it appears from time to time will be cited during the course.



INSECTS OF ECONOMIC IMPORTANCE

The science of economic entomology has made rapid progress during the last twenty years. It has advanced astonishingly in the number of persons engaged in the study of insects for the purpose of preventing their ravages, in developing and perfecting mixtures for repelling and killing insects, in devising effective apparatus for applying insecticides, and in determining more exact methods of preventing the losses caused by these persistent pests. The following outlines of lectures are intended to cover, as far as is possible in a brief, general course, the different phases of the subject of economic entomology as it exists to-day.

OBJECTS OF THE COURSE

(a) To become acquainted with the common insect pests and with their habits and life histories in order that they may be intelligently fought.

(b) To become acquainted with the modern and most practical methods of fighting insect pests.

TWO PHASES OF ENTOMOLOGY

(a) The pure science of entomology.

(b) The economic or applied science of entomology.

The pure science of entomology is a study of the kinds of insects together with their relationships to each other, their structure, habits, and transformations. It is a work of *culture* and *pleasure* and forms the basis of economic entomology.

Economic entomology is a study of the life histories and habits of injurious insects and the determination of some method whereby their ravages may be avoided or controlled.

LOSSES CAUSED BY INSECTS

The losses caused by insects in the United States alone, are estimated to aggregate more than a billion dollars

annually. They nearly equal the yearly expenses of the National Government and are more than the annual cost of the schools of the United States.¹

ANNUAL VALUE OF FARM CROPS AND LOSSES DUE TO INSECTS²

Product	Value	Percentage of loss	Amount of Loss
Cereals.....	3,000,000,000	10	300,000,000
Hay and forage	665,000,000	10	66,500,000
Cotton	850,000,000	10	85,000,000
Tobacco.....	100,000,000	10	10,000,000
Truck crops.....	300,000,000	20	60,000,000
Sugars	95,000,000	10	9,500,000
Fruits.....	150,000,000	20	30,000,000
Farm forests	110,000,000	10	11,000,000
Misc. crops	100,000,000	10	10,000,000
Animal products	3,000,000,000	10	300,000,000
Forests and their products			100,000,000
Products in storage			200,000,000
Total			\$1,182,000,000

Quaintance estimates the annual loss to the deciduous fruit interests of the United States as over \$66,000,000.

The annual loss to the people of the United States from malarial diseases carried by mosquitoes is not less than \$100,000,000.³ The loss to agriculture and other industries as a result of malaria is enormous.⁴

The loss that has been caused by yellow fever, carried only by mosquitoes, cannot now be estimated but was certainly very great.

Typhoid fever, due in large measure, at least, to its dissemination by the house-fly causes a very great annual monetary loss.

The Mexican cotton-boll weevil costs Texas, at least, \$25,000,000 annually, and when it spreads over the whole cotton area will cause a yearly loss of \$250,000,000.

The Hessian wheat-fly in 1900 cost the wheat growers \$100,000,000.

The chinch bug during the last 15 years from 1894 to 1909 has caused an estimated loss of \$350,000,000.⁵

¹Marlatt—Yearbook, U. S. Dept. Agri., 1904, p. 461.

²Sanderson—Insect Pests of Farm, Garden, and Orchard.

³Howard—Bull. 78, U. S. Bu. Ent.

⁴Herrick—Popular Science Monthly, April, 1903.

⁵Webster—Circ. 113, U. S. Bu. Ent.

The codling moth causes the fruit growers of the U. S. a loss of over \$12,000,000 and of New York, alone, more than \$3,000,000 annually.

COST OF FIGHTING INSECTS

To the destruction occasioned by insects must be added the cost of fighting them.

It is estimated that it costs \$4,000,000 to spray the apple trees in the United States for the codling moth.

It is said that it costs \$10,000,000 annually to spray for the San Jose scale.

It costs \$10,000,000 to screen against the house-fly.

The New England States and the Federal Government have already spent \$7,000,000 in fighting the gipsy and brown-tail moths and at the present time, are spending fully \$1,000,000 per annum.

OUR INSECT FOES ARE INCREASING

They are coming from foreign countries—San Jose scale gipsy moth, Mexican cotton-boll weevil, and many others—unaccompanied by natural checks.¹

Out of 73 of our worst pests, 37 or over half have been imported from foreign countries.

Insects once harmless become serious pests owing to changed conditions—Colorado potato beetle, blister-mite, white grubs.²

Happily, not all insects are injurious; many of them are beneficial.

USEFUL INSECTS

Silk-worms furnish material for clothing.

Scale insects produce a waxy material that is used in making shellac, and wax.³ The pulverized bodies of certain species furnish cochineal.

Bees furnish honey to the annual value of \$2,000,000 in New York alone. There are 30,000 beekeepers in New

¹Howard—U. S. Dept. Agri., Yearbook 1897, p. 529.

²Herrick—Cornell Countryman, 1910, Vol. 8, No. 2, p. 28.

³Comstock—Report for 1880.

York and 3,000,000 in the United States. Bees also aid in the cross-pollination of flowers. Bumblebees perform a notable service in cross-pollinating clover.¹

The Blastophaga, a minute wasp-like insect cross-pollinates the cultivated and wild fig, thus making possible the production of the Smyrna fig in California.²

PREDACEOUS INSECTS

Many species of insects catch and devour other species for food. These are known as *predaceous* insects and they are of immense value in aiding man in the fight against his insect foes.³

The ladybird beetles are probably the most important. There are several species, the two-spotted ladybird (*Adalia bipunctata*), the twice stabbed (*Chilocorus bivulnerus*), the convergent lady bird (*Hippodamia convergens*), and other species.

Many larvæ of a family of flies, the *Syrphidæ*, perform great benefit in destroying plant lice.

The ground-beetles (*Carabidæ*) are exceedingly beneficial in destroying insects that are found upon or in the soil.

Other beetles, flies, wasps, ants, etc., all contribute to the good work.

PARASITIC INSECTS

There are many insects that live upon or within the eggs or bodies of other insects and derive the nourishment necessary for their growth from their living hosts. These are called parasitic insects and they are among the best natural checks of insect pests.⁴

One of the most interesting and effective groups of parasitic insects is the tachinid flies (Family—*Tachinidæ*).

Probably the greatest number of parasites are found in the order *Hymenoptera*. For example, the ichneumon-flies, braconid-flies, chalcis-flies and the proctotrypid-flies.

¹Waldron—Report of North Dakota Sub-Expt. Sta., at Dickinson, 1908.

²Howard—U. S. Dept. Agri. Yearbook 1900, p. 79.

³Sanderson—Insect Pests of Farm, Garden, and Orchard, p. 9.

⁴Smith—Insect Friends and Foes.

ENTOMOLOGICAL LITERATURE

No one volume could contain descriptions of them all. Twenty-five thousand or more species from N. A. Descriptions and life histories would fill 150 vols.

OUR MAIN SOURCES OF INFORMATION

1. Bulletins of the State Entomologist, Education Building, Albany, N. Y.
2. Bulletins of the State Experiment Station, Geneva, N. Y.
3. Bulletins of the Cornell University Experiment Station, Ithaca, N. Y.
4. Bulletins of the U. S. Bureau of Entomology, Washington, D. C.
6. Farmers' Bulletins of the U. S. Dept. Agriculture, Washington, D. C.
7. Yearbooks of the U. S. Department of Agriculture, Washington, D. C.

SOME BOOKS

Manual of Fruit Insects, by M. V. Slingerland and C. R. Crosby, MacMillan Co.

Insect Pests of Farm, Garden and Orchard, by E. D. Sanderson, John Wiley & Sons.

Insects Injurious to Vegetables, by F. H. Chittenden, Orange Judd Co.

Insects and Insecticides, by Weed, Orange Judd Co.

Economic Entomology, by J. B. Smith, J. B. Lippincott Co.

Insects Injurious to the Household and Annoying to Man, by Glenn W. Herrick, MacMillan Co.

Manual for the Study of Insects, by J. H. Comstock, Comstock Pub. Co.

NUMBER OF INSECTS

Over 350,000 now known and described. Estimated to be from two to ten millions. Over 25,000 from North America. Several thousand are being described each year.

GROUPS CONTAINING THE PRINCIPAL INJURIOUS INSECTS

1. *Orthoptera*—Crickets, grasshoppers, cockroaches, et. al.
2. *Hemiptera*—aphids, scale insects, chinch bugs, et. al.
3. *Lepidoptera*—butterflies and moths..
4. *Diptera*—flies.
5. *Coleoptera*—beetles.
6. *Hymenoptera*—sawflies, bees, ants, wasps, et. al.

Again, all of the injurious insects may be gathered into two great groups, dependent upon the structure of their mouthparts. These are the *sucking* and *biting* insects.

a. Sucking insects

These are represented by the aphids, bugs, and flies.

b. Biting insects

These may be represented by the grasshoppers and beetles.

METHODS AND MATERIALS FOR THE CONTROL OF INSECT PESTS

Ideas and practices of ancient times and peoples.

Modern ideas and practices are based on two main methods, natural and artificial.

NATURAL METHODS

Hand-picking—tomato worms, tobacco worms, squash bugs.

Cutting out by hand—peach-tree borer, apple-tree borers.

Covering plants to protect them—cucumber beetles.

Hopper-dozers—for grasshoppers and leaf-hoppers.

Burlap and cotton bands—for canker-worms and codling moth.

Sticky bands—for canker-worms and gipsy moth.

Sticky shields—for leaf-hoppers.

Barrier method—for chinch bug and army worms.

Collecting eggs—gipsy moth and tent caterpillars.

Collecting larvæ—brown-tail moth.

Burning branches and trees—for shot-hole borer, bronze birch borer, twig girdler, raspberry cane-girdler, et. al.

Cleaning up rubbish and weeds—for cabbage insects, cotton-boll weevil, plum curculio, et. al.

Burning straw, leaves, and grass—for Hessian fly and chinch bugs.

Planting early—for cotton-boll weevil,

Planting late—for corn root-worm and Hessian fly and pea weevil.

Plowing in fall—for wire worms and for white grubs.

Rotating crops—for white grubs, for corn bill-bugs, and for many pests.

Resistant varieties of plants—Kieffer pear, Amer. grape stocks, spy root-stocks.

Use of commercial fertilizers—very little if of any use directly. Of use in accelerating growth to hasten maturity and to make strong resistant plants. Phosphoric acid and cotton.

Refraining from planting badly infested crops for two or three years—chinch bugs and wheat, boll-weevil and cotton.

Isolating fields—For cotton-boll weevil, et. al.

Mowing crops early—clover seed insects.

PROTECTING BIRDS—Birds should be protected and encouraged to make their homes on the farm and about the orchards. They help to hold the balance of nature and certainly aid greatly in holding insects in check.

One hawk after a chicken condemns the whole bird tribe; the great horned owl is a friend of man wherever mice and rabbits abound, but where these are scarce, as in thickly populated districts the owl is driven to other food; the sharp-shinned and cooper's hawk are enemies to wild birds and chickens and should be killed; other hawks and owls feed mostly on mice and insects; many species of birds are known to live almost wholly upon insects.

Insects constitute 65% of the annual food supply of the downy woodpecker, a very large percent of the food of warblers, 95% of the food of the house wren, and 96% of

the food of the flycatchers. Three hundred to five hundred insects have been found in the stomach of one bird.

The mobility of birds makes them very efficient. Forbes showed that in orchards where canker-worms were abundant birds became abnormally plentiful.

Flycatchers and swallows live upon flying insects, while robins and meadowlarks catch ground insects. Cuckoos, orioles, warblers, and vireos devour leaf-eating insects while nuthatches, titmice, and creepers explore trunks of trees for small insects.

References on the work of birds:

Henshaw—U. S. Dept. Agri., yearbook 1907, p. 165.

Beal—U. S. Dept. Agri., yearbook 1908, p. 343.

Sanderson—New Hamp. Expt. Sta., 19th and 20th Rpts., 1908, p. 398.

Forbush—Useful Birds and their Protection.

INTRODUCTION OF PREDACEOUS INSECTS—Predaceous insects, especially ladybird beetles and certain ground beetles are sometimes introduced into a locality to prey upon injurious insects. For example, the Australian ladybird (*Novius cardinalis*), the ground beetle (*Calosoma sycophanta*), and the convergent ladybird (*Hippodamia convergens*).

INTRODUCTION OF PARASITIC INSECTS—Parasitic insects are introduced into one country from another to help in the fight against insect pests. For example, the many parasites introduced from Europe to prey upon the gipsy and brown-tail moths.

ARTIFICIAL METHODS

Artificial methods consist mainly in the use of insecticides.

The kind of insecticide used will depend upon the kind of mouthparts the pest has, whether biting or sucking.

It will also depend somewhat upon the life history and habits of the pest.

There are two main kinds of insecticides.—(a) Poisons for biting insects; (b) contact substances for sucking insects. Gases are also used for both biting and sucking insects.

POISONS FOR BITING INSECTS

Several forms of arsenical poisons are used for killing insects that eat the foliage of plants. Arsenate of lead, however, is more universally used in orchard work than any of the others. The following are some of the poisons employed:

1. White arsenic.
2. Paris green.
3. Arsenate of lead.
4. Arsenite of zinc.
5. Arsenite of lime.
6. Arsenite of copper.
7. London purple.
8. Paragrene.
9. Hellebore.

ARSENIC

White arsenic (As_2O_3) is a white heavy powder and the cheapest form of a poison insecticide. Unfortunately, it is soluble in water and therefore will burn foliage. It can be used in combination with lime or Bordeaux mixture, however, if the proper precautions are taken.

In the following formulas the arsenic is combined with lime and the material is known as arsenite of lime.

Taft formula ¹	$\left\{ \begin{array}{l} 1 \text{ lb. white arsenic} \\ 2 \text{ lbs. quick lime} \\ 2 \text{ gals. water} \\ \text{Boil together for 40 min. and dilute to 300 gal-} \\ \text{lons with water.} \end{array} \right.$
Kedzie formula ²	$\left\{ \begin{array}{l} 1 \text{ lb. white arsenic} \\ 4 \text{ lbs. crystals sal soda} \\ 1 \text{ gal. water} \\ \text{Boil together until dissolved—about 15 or 20} \\ \text{min. Use 1 pint to 50 gals. water with 2} \\ \text{or 3 lbs. quick lime added.} \end{array} \right.$

¹Woodworth and Colby—Calif. Bull. 126, p. 23.

²Quaintance—U. S. Yearbook 1908, p. 275.

Common formula¹ $\left\{ \begin{array}{l} 1 \text{ lb. white arsenic} \\ 1 \text{ lb. sal soda} \\ 1 \text{ gal. water} \\ 2 \text{ lb. quick lime.} \end{array} \right.$

Dissolve the white arsenic and sal soda in the water by boiling all together in an iron vessel for about 15 or 20 minutes. Use this solution while hot to slake the lime. Add enough water to make 2 gallons. Use 2 quarts of this to 50 gallons of water.

Another method of making arsenite of lime is to boil 1 pound of white arsenic and 4 pounds of quick lime in 4 gallons of water for half an hour and then dilute to 200 gallons of water. The arsenic may not all combine with the lime thus causing burning. These combinations of arsenic and lime have not given satisfaction when used with lime-sulphur.²

PARIS GREEN

First used against Colorado potato beetle about 1868; 2000 to 3000 tons used every year; it is composed of white arsenic,³ copper oxide, and acetic acid. When pure it consists of 58.65% arsenious oxide, 31.29% copper oxide, 10.06% acetic acid.

Paris green⁴ is a coarse powder and not easily held in suspension. It is objectionable for this reason. Not over 3% should be soluble and it cannot be used on conifers. At least 1 pound of freshly slaked lime should be mixed with every pound of paris green to take up the soluble arsenic and prevent burning of the foliage. It cannot be used with fungicides containing ammonia.

STANDARD FORMULA

Paris green	4 oz.	Paris green	1 lb.
Quick lime	1 lb. or	Quick lime	2 lbs.
Water	50 gals.	Water	200 gals.

Stewart recommends 1 pound of paris green per acre of potatoes whether 50 gallons or 100 gallons of Bordeaux

¹Slingerland, Herrick, Crosby—Cornell Bull. 283, p. 476.

²Scott—Circ. 54, U. S. Bu. Plt. Ind., p. 14.

³Lodeman—Spraying of plants, pp. 59-74.

⁴Smith—New Jersey Bull. 213.

are applied. If the poison is used in water alone then 1 or 2 pounds of quick lime should be slaked and added.

IMPURITIES AND TESTS FOR¹—Paris green can be tested in three simple ways for impurities: 1. *Ammonia test*. Paris green dissolves wholly in ammonia leaving no residue; 2. *Glass slide test*. Pure paris green jarred on a slide leaves a bright green streak. If impure the streak is whitish or pale green; 3. *Microscopic test*. Under the microscope the crystals of paris green appear like clean round balls. The crystals of the impurities will appear angular, irregular and whitish.

ARSENATE OF LEAD²

The paste form—Was first used in fighting the gipsy moth in New England in 1893. In 1908, 2,500 tons sold.

A compound³ of arsenic oxide and lead oxide; remains in suspension better than paris green; is white in color; will not ordinarily burn foliage; sticks to plant much better; several applications may injure peach foliage.

The commercial brands vary from 12% to over 20% arsenic oxide⁴—the average being about 15%. They usually contain less than 1% soluble or free arsenic.

Some brands are acid,⁵ and these when mixed with lime-sulfur seem to form calcium arsenate which when decomposed forms soluble arsenic and burning results. Apparently arsenic is also set free from these acid brands under certain atmospheric conditions.⁶

INJURY TO FOLIAGE BY ARSENATE OF LEAD—The water in which the arsenate of lead is suspended seems to have some determining effect upon the injury caused.⁷ Distilled water with salt added causes decided injury to foliage; distilled water with sodium carbonate added causes decided injury; distilled water alone almost no injury; distilled water with lime added almost no injury.

¹Woodworth & Colby—Calif. Bull. 126.

²Burgess and Rogers—U. S. Bu. Ent. Bull. 87, p. 17.

³Smith—New Jersey Bull. 213, p. 11.

⁴Haywood and McDonnell—U. S. Bu. Chem. Bull. 131.

⁵Wallace—Cornell Bull. 288, p. 120.

⁶Volck—Science, Vol. 33, 1911, p. 866.

⁷Haywood and McDonnell—U. S. Bu. Chem. Bull. 131.

Clear sunny weather following application seems favorable to injury; dew followed by sunshine seems favorable to injury.

Soap, and its effect in holding arsenate of lead in suspension.¹

Drying of the paste and its effect on the powers of suspension.

THE POWDERED FORM—An amorphous form of fine powder; first used in fighting the Mexican cotton-boll weevil; said to contain 33% arsenious oxide (Vreeland's Electro Brand); does not seem to remain in suspension quite as well as the paste; very little known of its sticking qualities.

HOME MIXTURE²—A small quantity can be made advantageously at home but proper chemicals are hard to get. There are two formulae:

Arsenate of soda 65%	8 oz.
Lead acetate (sugar of lead)	22 oz.

or

Arsenate of soda 65%	8 oz.
Lead nitrate	18 oz.

The lead nitrate remains in suspension a little better than lead acetate.

Dissolve each ingredient separately in two gallons of hot water in a wooden or earthen vessel; pour together and dilute to 50 gallons.

ARSENITE OF ZINC, "ORTHO-40"

History of and climatic conditions in the Pajaro Valley, Calif.; content of arsenious oxide (40%); can be used on potatoes but burns foliage of many fruits when used alone. One pound of zinc arsenite equals three pounds of arsenate of lead.³

ARSENITE OF COPPER OR SCHEEL'S GREEN⁴

Differs from paris green in lacking the acetic acid. It is finer than paris green and consequently remains in suspension better.

¹Cooley—Montana Bull. 86.

²Haywood and McDonnell—U. S. Bu. Chem. Bull. 131.

³Schoene—New York (Geneva) Tech. Bull. 28.

⁴Lodeman—The Spraying of Plants, p. 120.

GREEN ARSENOID AND PARAGRENE

These are similar poisons.¹ Paragrene, however, has a large percent (27%) of gypsum and also too much free arsenic—6.12% soluble arsenious acid.

“SLUG-SHOT”

This appears to be mostly composed of gypsum and not of much value as an insecticide.²

BUG DEATH

Is another trade insecticide of no value for it is largely composed of zinc and iron oxids.³

BLACK DEATH

It is composed mostly of gypsum.⁴

LONDON PURPLE⁵

It is a waste product in the manufacture of aniline dyes; contains a large percent of soluble arsenic and must have lime added in liberal amounts to prevent burning; costs only 10c a pound; is not so effective as the copper arsenites (paris green, etc.)

HELLEBORE⁶

It is a whitish poisonous powder obtained from pulverizing the roots of the white hellebore plant. It is apt to lose its strength quickly and often difficult to obtain fresh. Can be applied to ripening fruit without fear of poisoning, because its strength is so rapidly lost in open air. It is valuable for the currant worm and is usually applied dry either pure or mixed with flour or lime at the rate of 1 to 3; may be applied wet by steeping 1 ounce in a quart of water and adding another quart of cold water.

¹Woods—Maine Bull. 68, p. 176.

²Van Slyke—Geneva Bull. 165.

³Smith—New Jersey Bull. 214, p. 14.

⁴Van Slyke—Geneva Bull. 165.

⁵Marlatt—U. S. Farmers' Bull. 127, p. 8.

⁶Smith—New Jersey Bull. 213, p. 29.

POISON BAITES

A mixture of fruit juice, bran, and paris green for cutworms, grasshoppers, and army worms has proven very efficient. The formula for the army worm recommended by the U. S. Department of Agriculture is as follows: 1 pound of paris green, 50 pounds of wheat bran and the juice of one-half dozen oranges. Bring this mixture to a stiff dough by the use of dilute molasses and scatter among worms.

The formula¹ used so successfully in Kansas for poisoning grasshoppers is as follows: 1 pound of paris green, 20 pounds of wheat bran, 2 quarts of syrup, the juice and pulp of 3 oranges or lemons, and 3½ gals. water. The bran and paris green are thoroughly mixed while dry. The juice of the oranges is squeezed into the water after which the pulp and skin are chopped fine and added to the water. The syrup is then poured into the water and this liquid mixture of fruit juice, syrup and water is used to thoroughly dampen the bran and paris green. The bait is sown broadcast in the infested fields in the early morning.

A mixture of bran, 10 pounds, moistened with water, and 1 pound of white arsenic, sweetened with one or two quarts of molasses has proven effective for cutworms. Place a tablespoonful at the base of each cabbage plant or distribute in rows across the field.

Freshly cut clover dipped in a strong arsenical solution is effective for cutworms. Renew as often as it dries.

Slices of potatoes dusted with an arsenical distributed about beds in a greenhouse are effective against sowbugs.

CONTACT SUBSTANCES FOR SUCKING INSECTS

1. Pyrethrum.
2. Tobacco.
3. Soaps.
4. Oils.
5. Lime-sulfur.
6. Carbolic-acid emulsion.

¹Dean—Jr. Ec. Ent., Vol. 7, p. 67.

PYRETHRUM

Commonly called Persian Insect Powder¹, Dalmatian powder, and Buhach; formerly imported from Persia under two first names; now manufactured in California under name Buhach. It is a powder made from the pulverized flower heads of *Chrysanthemum* sp.; contains a volatile oil and kills by contact; harmless to human beings and to plants. It is expensive and quickly loses its effectiveness when exposed to the air. Buhach is most apt to be fresh. It is used chiefly in greenhouses and in the household where it is usually sifted dry on the plants or in the rooms. It may be applied wet by steeping 1 ounce in a quart of boiling water for 5 or 10 minutes to which 3 quarts of cold water should be added.

TOBACCO

The insecticidal power of tobacco is due to the nicotine it contains. Is often used as a dust² against plant and animal lice and against ticks. It is said to be useful in controlling the woolly aphis on the roots of apple trees and also acts as a good fertilizer. It is a waste product of tobacco factories and costs about 1 cent per pound.

Tobacco stems² or leaves may be cooked or steeped in water to remove the nicotine and form a decoction. Unfortunately, the nicotine content of tobacco varies with the variety, soil, method of curing and other factors³ and it is therefore impossible, without chemical analysis, to make a standard decoction. In general, 1 pound of stems in a gallon of water brought to the boiling point and when drained off enough water added to make a full gallon will give a decoction of sufficient strength to kill plant lice. It is best to rely on commercial extracts whose nicotine contents are known.

COMMERCIAL TOBACCO EXTRACTS—Two tobacco extracts (liquid) are now manufactured and sold commercially under the names of "Black leaf 40" and "Nico-

¹Marlatt—U. S. Farmers' Bull. 127, p. 16.

Coquillett—U. S. Bu. Ent., Bull. 12, o. s.

²Smith—N. J. Bull. 213, p. 28.

³Ellet and Grissom—Vir. Bull. 208.

fume". The former is a sulphate of nicotine and therefore an acid material. It contains 40% nicotine, costs \$10.75 per gallon (10 lbs.) and is usually diluted at the rate of 1 gallon to 800 or 1000 gallons of water. It may be combined with lime-sulfur but when so combined a precipitate is formed. Whether the insecticidal value of the tobacco extract is modified by this combination has not yet been accurately determined.

The "Nico-fume" also contains 40% nicotine but the latter is free and therefore more readily volatile. It is used in greenhouses by vaporizing it at the rate of one-half ounce to 2000 cubic feet. It is also used for spraying plants. It costs \$10.50 per gallon (8 lbs.)

SOAPS¹

Ordinary laundry soap, 1 pound to 5 or 6 gallons of water is a good insecticide for the garden, lawn, and household plants. Soft soap should be used twice as strong.

Whale-oil soap is a better insecticide. One should always procure a potash soap. It costs 3 to 6 cents per pound. Use 1 pound to 5 or 6 gallons of water for summer application. In winter, for scale, use 2 pounds to 1 gallon. Whale-oil soaps vary greatly in their water content and are liable to contain free potash² thus causing burning. Fish-oil soap can be made easily and cheaply at home. The composition may be known and the free potash avoided.

Formula for home-made fish-oil soap:²

Caustic soda	6 lbs.	or 1½ lbs.
Water	1½ gals.	or 1½ qts.
Fish-oil	22 lbs.	5½ lbs.

Dissolve the caustic soda in the water. After the soda is dissolved, add the fish-oil gradually, in the meantime stirring the mixture thoroughly and vigorously. Complete and thorough stirring while the oil is being slowly poured into the water and soda is absolutely necessary. Use 1 pound to 6 or 7 gallons of water.

¹Marlatt—U. S. Farmers' Bull. 127, p. 15.

²Van Slyke & Uner—Geneva Bull. 257.

Fish-oil may be purchased of N. B. Cook Oil Co., New York.

OILS

Mineral oils are much used for contact insecticides, usually in some form of an emulsion that is miscible with water. They are particularly valuable against aphids, and scale insects.

KEROSENE EMULSION¹—Kerosene may be emulsified with milk or soap, the latter being now most universally used.

Formula for kerosene emulsion:

Soap.....	1 lb.	Soap	½ lb.
Soft water.....	2 gals. or	Water	1 gal.
Oil	4 gals.	Oil	2 gals.

The soap is shaved fine and heated in the water until dissolved. The oil is poured in and while the mixture is hot it is briskly agitated until a white creamy mixture is formed. The following dilutions apply to first formula:

To make a 10% solution for summer spraying add 34 gals. water.

To make a 20% solution for dormant spraying add 14 gals. water.

To make a 25% solution for dormant spraying add 10 gals. water.

CRUDE PETROLEUM EMULSION—It is made exactly as the kerosene emulsion. The grade of oil used is called "insecticide oil". It should have an amber color and its specific gravity should run from 43 to 45 degrees Beaumé. A 20 to 25 percent solution is valuable as a winter spray.

OIL IN MECHANICAL EMULSION WITH WATER²—It has always been tedious to make oil emulsions and to obviate the labor, pumps were designed to mix the oil mechanically with water. These pumps were supposed to throw any per cent of oil in water desired, by the regulation of a valve. The pumps proved unreliable and severe injuries often resulted from using them. They are not now in use.

¹Marlatt—U. S. Farmers' Bull. 127, p. 20.

²Marlatt—U. S. Farmers' Bull. 127, p. 20.

MISCIBLE OILS¹—These are proprietary mixtures containing mineral oils in combination with a small quantity of vegetable oil and some alkali to make them miscible with water. They are designed especially for the control of scale insects. They mix readily with water. There are several prominent brands: "Scalecide", "Kil-O-Scale", "Target-Brand", and "Orchard Brand".

HOME-MADE MISCIBLE OILS²—Prof. C. L. Penny has developed methods of preparing miscible oil at home. There are two steps in making a miscible oil: (1) preparing the emulsifier or soap solution, (2) mixing the mineral and vegetable oils with the emulsifier to produce the final product, miscible oil. The process is rather long and laborious.

CARBOLIC ACID EMULSION

This emulsion is formed by dissolving 1 pound of hard soap in 1 gallon of hot water. After the soap is dissolved, add 1 pint of crude carbolic acid. Then agitate the mixture until an emulsion is formed. For use, dilute with 30 parts of water.

LIME-SULFUR³

It is probably the best and most universally used insecticide for scale insects. It is also practically a specific for blister-mite and of great use in controlling the pear psylla, certain fungus diseases, etc. It was used originally as a sheep dip but was first tried as an insecticide in California in 1886. It was not tried in the East until 1894 when its use did not seem to prove successful. Nothing more was done with the lime-sulfur wash in the East until 1900 when it was tried again and gave promising results. The first formulae included salt. Later formulae differed somewhat in proportions, but the following is a representative one: Quick-lime, 20 pounds; sulfur, 15 pounds; water, 50 gallons.

¹Marlatt—U. S. Farmers' Bull. 127, p. 23.

²Penny—Ann. Rpt. Penn. State Coll., 1907-08, p. 228.

Phillips—Va. Bull. 179.

³Quaintance—U. S. Yearbook 1906, p. 429.

Place lime in iron kettle and slake it with hot water. Add sulfur and more water and boil for one hour. Dilute to 50 gallons, strain, and use while hot if possible.

CONCENTRATED COMMERCIAL SOLUTIONS¹—Within the past few years commercial concentrated lime-sulphur solutions have been introduced into this state and have been used by many fruit growers in combating certain insect pests and fungus diseases. In order to use one of these mixtures intelligently and effectively it becomes necessary to know its strength or, in other words, its degree of concentration. This is best found by using an instrument known as a Beaumé hydrometer. In testing a lime-sulfur solution, simply pour some of the clear reddish liquid into any deep receptacle, deeper than the hydrometer is long, and when full, gently drop the instrument into the solution and wait until it comes to rest. Then read on the hydrometer the degree of concentration, which will be the one just at the surface of the liquid. When the degree of concentration of the liquid is known, the proper dilution may be obtained by referring to the following tables computed by Mr. P. J. Parrot of the Geneva Experiment Station.

Reading of hydrometer or degree of con- centration	Amount of water to one gallon of the lime-sulphur solution			
	For San José Scale		For blister-mite	
Degrees Beaumé	Gals. Lime-Sulfur	Gals. Water	Gals. Lime-Sulfur	Gals. Water
25	1	5	1	7
26	1	5¼	1	7½
27	1	5¾	1	8
28	1	6	1	8½
29	1	6½	1	9
30	1	6¾	1	9½
31	1	7¼	1	10
32	1	7½	1	10½
33	1	8	1	11
34	1	8¼	1	11½
35	1	8¾	1	12

¹Parrott & Schoene—Geneva Bull. 320.

HOME-MADE CONCENTRATED SOLUTION¹—The concentrated solution can be made at home with a fair degree of success. The lime used should contain not less than 90% calcium oxid and not over 5% magnesium. The formula is as follows:

Quick lime	{ pure lime.....	36 lbs.
	{ 95% CaO	38 "
	{ 90% CaO	40 "
Sulfur flour or flowers of sulfur		80 "
Water		50 gals.

Place lime in kettle and slake with 10 gallons of water. While lime is slaking add the sulphur which has been previously mixed with water into a paste. Stir thoroughly and when lime is entirely slaked add enough water to make about 60 gallons if the boiling is over an open fire. If the boiling is with live steam add enough water to make 50 gallons. Boil the mixture vigorously for one hour.

When through strain; store in tight containers. Usually lime-sulfur will not freeze down to 5° above zero.

For San José scale the diluted solution should test 4.5 degrees B.; for the blister-mite 3.5 B.; and for summer use on foliage 1 degree B.

The concentrated solutions of lime-sulfur have shown themselves to be useful against San José scale in the summer even when diluted for use on foliage.²

THE SELF BOILED LIME-SULFUR—This has been found to be of use in checking San José scale³ in the summer. Place 8 pounds of quick lime in a barrel and start it slaking with a small amount of cold water. Work 8 pounds of sulfur through a sieve and add slowly to the slaking lime. Add enough cold water to slake the lime and stir constantly. As soon as slaking is completed (5 to 15 min.) fill barrel with cold water (50 gallons). Peaches and plums can be sprayed in foliage with this and the scale checked if hit when young are hatching.

¹Parrott & Schoene—Geneva Bull. 330.

²Stewart—Ann. Rpt. Penn. State Coll. 1910-11, p. 268.

³Quaintance—U. S. Yearbook 1908, p. 277.

SOLUBLE SULFUR—Attempts have been made to manufacture a soluble sulfur compound in a dry form to take the place of the liquid solution. A dry form of sulfur, if it could be made as effective as the liquid form, would be very desirable. It would save freight when purchasing and would be easier to handle. Further investigation of these dry compounds is necessary.

FUMIGATING SUBSTANCES

Several substances are used to fumigate mills, green-houses and dwellings in order to destroy the insects that may be infesting such buildings.

CARBON BISULPHIDE¹—This liquid is used as a fumigant against stored grain insects especially and sometimes against root-feeding insects, aphids, white grubs, ants, etc.

It is heavier than water; readily volatile; and when pure it has not an unpleasant odor. The gas from the liquid is heavier than air and is suffocating. The gas is also inflammable and explosive.

Use 2 pounds of the liquid² to 1000 cubic feet of space when temperature is between 65 and 75 degrees F. Granary must be tight. Peas, beans, seed corn, etc., can be stored in barrels and treated.

A cheap form of carbon bisulphide under the trade name "Fuma", is sold by Edward R. Taylor, Penn Yan, N.Y.

HYDROCYANIC ACID GAS—It is a very poisonous gas used against household insects, citrus pests, stored grain insects, and for the fumigation of nursery stock.

Formula for household fumigation for 100 cubic feet space:

Water	3 oz.
Sulfuric acid	1 oz.
98% potassium cyanide	1 oz.

Formula for nursery stock for 100 cubic feet space:

Water	4 oz.
Sulfuric acid 66°	2 oz.
98% potassium cyanide	1 oz.

¹Hinds—U. S. Farmers' Bull. 145.

²Chittenden and others—U. S. Bu. Ent. Bull. 96, Part III.

For house fumigation¹ all holes in rooms should be stopped and all cracks covered with strips of newspaper soaked in water.

In fumigating trees tents are used². In fumigating nursey stock for scale insects a special room is needed.³

FORMALDEHYDE GAS—This is primarily a germicide. It has been shown to be practically useless as an insecticide.

TOBACCO PAPERS—Paper soaked in tobacco extract is sold for fumigation purposes in greenhouses. These papers will burn when lighted and are much more convenient to use in houses than tobacco stems.

HEAT⁴—Within the last few years heat has been used to some extent in mills in the western part of the United States, at least, to kill mill insects. According to Dean and Goodwin heat is a very efficient and satisfactory agent for destroying grain insects. The temperature necessary to kill stored grain insects ranges from 118° to 125° F. Felt has shown that cockroaches succumb to a temperature of 120° F. It is necessary to maintain the heat for several hours to allow it to penetrate all of the infested parts of the building. There seems to be no reason why heat could not be utilized in killing household insects if a practicable way can be found of developing a temperature of 120° F. in a house.

MISCELLANEOUS MEANS OF FIGHTING INSECTS

TRAP LANTERNS—Lights and lanterns have been recommended and used for many years to catch insects active at night. One called the Hazeltine lantern has been widely advertised. Several experiments have been made to demonstrate the usefulness or uselessness of lanterns for catching insects. Perhaps the most extensive one

¹Howard and Popenoe—U. S. Bu. Ent. Circ. 163.

Herrick—Can. Ent. Vol. 39, p. 341.

²Morrill—U. S. Bu. Ent. Bull. 76.

Woglum—U. S. Bu. Ent. Bull. 79.

Lowe—Geneva Bull. 181.

³Britton—Conn. Bull. of Immediate Information No. 3.

⁴Goodwin—Ohio Bull. 234.

Dean—Kan. Bull. 189.

Felt—27th Rept. State Ent., N. Y.

was made at Cornell during 1892. From May 20th to Oct. 1st 13,000 insects were caught; 77% were neutral, 10 2-5% beneficial, 12 3-5% often pests; of the pests, 84 to 93% were males; of the beneficial, 80 to 88% were females; nymphs and larvae were not caught; as many friends as foes were caught; not *one* codling moth taken.¹

In an all summer experiment Dr. Riley never caught a codling moth: Prof. Stedman caught only 2 with 4 lanterns running 100 nights.

GASOLINE TORCHES—An ordinary plumber's² torch or some modification of it has been proposed for killing insects, especially scale insects, on their food plants. Several trials by different experimenters on different insects indicate that these torches are hardly practicable. In most cases, the heat sufficient to kill the insects injured the plants.

TREE TANGLEFOOT—A sticky material manufactured by the O. W. Thum Co., Grand Rapids, Mich., at about 30c per pound is the same or similar material used in their tanglefoot fly paper. It is useful in putting about the trunks of trees to catch canker-worm moths, caterpillars of the tussock moth, etc.

TREELEIM—A substance manufactured by the Vreeland Chemical Co., which is used for the same purpose as tanglefoot and is said not to "glass" over but to remain fresh and sticky a long time.

SPRAYING

HISTORY OF SPRAYING—The currant worm became injurious about 1860 and the Col. Pot. beetle about 1865. Hellebore and paris green were used for these two pests and this suggested the use of the latter for other insects. Riley suggested its use on cotton in 1872; Le Baron suggested its use for the canker-worm in 1872. Cook advised spraying trees in 1877; E. P. Haynes, in 1878, sprayed trees for canker-worms and killed the codling moth. These were the beginnings. Our insect foes are increasing and we must spray.

¹Slingerland—Cornell Bull. 202.

²Forbes—Illinois Bull. 89.

SOME PRINCIPLES OF SPRAYING—Spray at the right time, before rains for most fungus diseases and after rains for insects alone. Watch the development of buds, blossoms, fruit and weather and spray accordingly and not by dates. Spray thoroughly. Every leaf and fruit should be coated. Use a nozzle, in general, that gives a fine spray and use at least 75 pounds pressure but better 150 pounds. Pattern after the bugs, be ready, and in case of doubt spray.

DUST SPRAYS—Dust sprays may consist of lime, dry Bordeaux and some arsenical or they may consist of a mixture of sulphur and an arsenical. These sprays were introduced to lower the cost and labor of spraying. They do both but the ultimate value of them rests on their efficiency.

Early experiments in dust spraying were made with dry Bordeaux with an arsenical. In this mixture the copper was the essential fungicide. The following is a formula¹ (Scott's), for this dust spray:

4 lbs. copper sulphate in 4 gals. water

4 lbs. lime in 4 gals. water

60 lbs. slaked lime dust

Dissolve the sulphate in the 4 gallons water and slake the lime in the 4 gallons. When cool pour together and allow it to settle. Decant or pour off the liquid, put the wet mass in a strong bag and squeeze out the remaining water. Then spread out and allow to dry in the sun. Pulverize this dry material and pass it through a sieve with 80 meshes to the inch and then mix with the 60 pounds of slaked lime. For Bird's formula see Mo. Bull. 60 or Cornell Bull. 216.

Comparative early experiments indicated that 6 sprayings with the dry material could be made as cheaply as four with the liquid. The dust spray can be more easily transported about an orchard, especially if the orchard is rough. It does not appear to have any other advantage, according to the early experiments.

¹Scott—U. S. Farmers' Bull. 243, p. 11.

Craig—Cornell Bulls. 216, 245.

Close—Delaware Bulls. 72 and 76.

The dust spray does not control fungus diseases as well as liquid Bordeaux. The dust proved irritating to workmen, getting into their lungs.

Crandall¹ says the "dust spray is absolutely ineffective as a preventive of injury from prevailing orchard fungi, and that it is considerably less efficient as an insect remedy than is the liquid method of applying arsenites."

During the years of 1913 and 1914 the Cornell Experiment Station made some extensive experiments in spraying trees with a mixture of dry sulfur and arsenate of lead at the rate of 4 parts sulfur to 1 part of the arsenical. The results of the experiments during 1913 are given in Bull. 340 of the Cornell Station.

PUMPS

Atomizers, hand sprinklers, buckets, knapsacks, barrel, power sprayers. The essentials of a good pump are brass or bronze working parts, ball valves, and readily accessible parts.

NOZZLES

1. The first nozzles threw a nearly round solid stream, like a garden hose.

2. The second group of nozzles consisted of those in which the stream having passed the orifice proper is modified by some obstruction that breaks it or scatters it. The "climax," "Ball," and "Lewis" are examples.

3. The third and most perfect type is known as the rotary or eddy-chamber nozzle. This is represented, typically, by the Vermorel. Later modifications are the "Friend" and "Mistry." It is of American origin although bearing a French name.

ACCESSORIES

TOWER—A tower ten or twelve feet high is a necessity for good work. It enables one to get above the tree and spray down, which is especially necessary in case of

¹Crandall—Illinois Bull. 106.

codling moth. The new Cornell tower has many advantages.

HOSE—There should be plenty of hose to enable one to get all around a tree. The hose should be of a quality to withstand 150 to 200 pounds pressure.

BORDEAUX MIXTURE

This is a fungicide with which arsenicals are often combined:

Formula	{	Copper sulfate	3 to 5 lbs.
		Quick lime	5 to 6 lbs.
		Water	50 gals.

QUARANTINE AND INSECTICIDE LAWS

Nearly all of the States in the United States have passed laws¹ governing the shipment of plants and plant products into their territories. These are designed, of course, to prevent the introduction of injurious insects and plant diseases. California has in some instances instituted legal restrictions governing shipments of plants between counties within the State. Similar restrictions have also been imposed in some of the Southern States to prevent the spread of the Mexican cotton boll weevil from one district to another within the State. These laws of the different States are intended to meet local conditions and are not uniform which results in much confusion.

THE NATIONAL QUARANTINE LAW—For many years there was in this country an agitation for a uniform, national quarantine law to govern the importation of nursery stock into the United States and to regulate the shipment of such stock among the States themselves. As a result of this demand, Congress passed such a law², which went into effect the first day of October, 1912. The law has two purposes: (1) to regulate the importation of nursery stock, other plants, and plant products from foreign countries into the United States

¹Burgess—U. S. Bu. Ent. Circ. 75.

²An Act to regulate the importation of nursery stock, etc. Public—No. 275.

to prevent the introduction of injurious insects and plant diseases; (2) to establish quarantines against any State, territory, or district of the United States or any portion thereof to prevent the distribution throughout the United States of any dangerous plant diseases or injurious insects.

To carry out the provisions of the law, a Federal Horticultural Board consisting of five members was appointed by the Secretary of Agriculture from certain Bureaus and offices in the Department of Agriculture.

THE NATIONAL INSECTICIDE LAW—Various States have undertaken at different times to regulate by law the composition of certain insecticides sold within their boundaries. Such laws have not been uniform and have been, on the whole, more or less unsatisfactory. In 1910 Congress passed a national insecticide law that went into effect the first day of January, 1911. Its object was to prevent the manufacture, sale, or transportation of adulterated or misbranded paris greens, lead arsenates, and other insecticides and fungicides. In this law it was decreed that paris green shall not contain less than 50 per cent arsenious oxide nor more than $3\frac{1}{2}$ per cent water-soluble arsenic and that lead arsenate shall not contain more than 50 per cent water, nor less than $12\frac{1}{2}$ per cent arsenic oxide (As_2O_5) nor more than .75 per cent water-soluble arsenic. It was also decreed that other insecticides and fungicides should not fall below the proposed standard or quality under which they were sold.

INSECTS INJURIOUS TO ORCHARD TREES AND FRUITS

APPLE PESTS

THE CODLING MOTH¹ (*Carpocapsa pomonella*)

Order—Lepidoptera. Manual p. 241

One of the oldest and most important pests on apples; estimated that it causes a yearly loss of \$12,000,000 in the United States with an added \$4,000,000 for cost of spraying trees to control it.

Eggs laid on leaves and fruit two or three weeks after petals fall; caterpillars emerge in about one week and 60 to 80% enter the young fruit through the calyx end; they live in the apple four weeks, or longer in many instances, and when full-grown leave the fruit through a hole made in the side of the apple; they then crawl to a crevice in the bark of the large limbs or trunks or find a nook elsewhere and spin a cocoon; here, some of the larvæ change to pupæ and issue as moths the latter part of July to form a second brood; a large part of the larvæ, however, remain under the bark until the following spring and then change to pupæ from which, in about twenty days, the adult moths issue.

CONTROL—Spray at once after three-fourths of the petals have fallen, with 150 pounds pressure, using 2 pounds of arsenate of lead to 50 gallons of water; this is the most important spraying and should be done thoroughly; spray from a tower into the calyx ends of the young apples; spray again in 3 or 4 weeks and cover fruit and foliage with a fine misty spray; again the last week in July for second brood.

¹Slingerland—Cornell Bull. 142.

Quaintance—U. S. Yearbook 1907, p. 435.

THE ROUND-HEADED BORER¹ (*Saperda candida*)

Order—Coleoptera. Manual p. 573

Next after the codling moth the worst pest on apples in the United States; eggs laid in June, and later in incisions made in the bark; the grubs hatch in 2 or 3 weeks and tunnel in the sapwood; they live mostly near the surface of the ground, but often below the earth, especially in young trees; at end of the second year the larvæ are quite large and are now deeper in the heartwood; the third year the larvæ gnaw to the bark and there pupate; the adult beetles emerge in May and June, the insect having taken three years for its life history; the beetle is a handsome long-horned one, about an inch in length and has two conspicuous white lines the whole length of its body.

CONTROL—Give orchards clean culture; cut out borers with a sharp instrument like a chisel and then apply some wash, for instance, concentrated lime-sulfur, or an alkaline wash made by adding caustic potash to soap and water until a thick creamy mixture is formed; washes should be applied up to the lower limbs and renewed once in 3 or 4 weeks.

FLAT-HEADED BORER² (*Chrysobothris femorata*)

Order—Coleoptera. Manual p. 549

The second thoracic segment of the larva is wide, flat, and close to the head, hence the name; the larva attacks many kinds of fruit-trees, forest and shade-trees, infesting by preference those diseased or dying; it inhabits all parts of the trunk from ground to branches; eggs are laid in cracks of bark; the larva lives just beneath the bark and burrows out broad, flat, irregular channels in the wood; as it grows it may go deeper into the wood; it matures in one year and the beetles emerge in May and June; the adult beetle has short antennæ, is of a dark metallic brown color, and about one-half inch long.

CONTROL—Same as for the round-headed borer.

¹Chittenden—U. S. Bu. Ent. Circ. 32.

²Chittenden—U. S. Bu. Ent. Circ. 32.

THE BUD-MOTH¹ (*Tmetocera ocellana*)

Order—Lepidoptera. Manual, p. 241

A most important pest on the apple in New York. The tiny dark brown caterpillars appear early in the spring and begin to attack the bursting buds; they bore into the buds and when the leaves begin to unfold attack those also; they continue to eat the leaves and tie them together, finally pupating within the tangled mass; the moths appear in June and lay their small inconspicuous eggs on the leaves; these hatch in about 10 days and the tiny caterpillars feed on the surfaces of the leaves eating the epidermis and tissues away leaving a network of veins; the caterpillar lives mostly in a tiny silken tube built along the midrib of the leaf; in September the caterpillars migrate from the leaves to the small branches where they build snug silken cases, called *hibernacula*, in which to pass the winter; these hibernacula are built, very often near the buds where the larvæ will find food close at hand in the spring. There is only one brood a year.

CONTROL—Spray with arsenate of lead, 2 pounds to 50 gallons, just as the tips of the buds begin to show green; repeat just before blossoms open; repeat again after petals fall which will also do for the first codling moth spray.

CIGAR CASE-BEARER² (*Coleophora fletcherella*)

Order—Lepidoptera

The half-grown caterpillars migrate in August and September from the leaves to the branches where they securely fasten their small curved cases preparatory to passing the winter; in the early spring the caterpillars in their cases become active, move to the buds and begin to attack them; later they attack the very young fruit but mostly mine in the leaves remaining all of the time in their cases; about the middle of June they pupate and the moths appear in July; the very small moths lay

¹Slingerland—Cornell Bull. 50.²Slingerland—Cornell Bull. 93.

their eggs on the leaves; these hatch in about 2 weeks and the tiny caterpillars spend the remainder of the summer mining in the leaves.

CONTROL—Spray with arsenate of lead, 2 pounds to 50 gallons of water just as the tips of the buds begin to show green; again before the blossoms open; and again after petals fall. This is the same as for the bud-moth.

PISTOL CASE-BEARER¹ (*Coleophora malivorella*)

Order—Lepidoptera

Its case is shaped like a pistol and its life history is very similar to that of the cigar case-bearer; the larva, however, does not mine in the leaves but eats the surfaces of them.

CONTROL—Same as for cigar case-bearer.

THE EUROPEAN GRAIN APHIS² (*Aphis avenae*)

Order—Hemiptera

This aphid is an European insect and has been observed on twenty-two plants—apple, pear, quince, plum, rye, oats, wheat, et al.; it is one of the early aphids appearing in the spring on apple buds but usually leaves the apple without doing much harm; it is light green in color with a dark line down the middle of its back.

Passes winter as dark eggs on branches; these hatch in spring; may be several generations on apple leaves; the winged generation flies to grasses where many (13) generations are produced during the summer; many live on wheat in fall; the winged females finally fly back to the apple tree in the fall and produce a generation of true wingless females which lay the true winter eggs on the bark.

CONTROL—No satisfactory method of destroying the eggs has been discovered. For the aphids spray opening buds with "black leaf 40", $\frac{3}{4}$ pint to 100 gallons of water

¹Slingerland—Cornell Bull. 124.

²Quaintance—U. S. Bu. Ent. Circ. 81.

Davis—U. S. Bull. 112.

with 4 pounds of soap added; also 10% kerosene emulsion or whale-oil soap, 1 pound to 5 gallons of water. Repeat if necessary.

THE ROSY APPLE APHIS¹ (*Aphis sorbi* = *Aphis malifoliae*)

Order—Hemiptera

The rosy aphid is larger than the grain aphid and is usually of a rosy color although individuals may be tan, grey or blackish; the body is noticeably roundish or globular; it is considered quite injurious here.

Winters as eggs upon trunk and twigs of trees; hatch in spring and produce probably three broods; in late June the winged generation goes to some unknown food plant; late in fall winged mothers return to apple trees and give birth to true females that soon lay winter eggs.

CONTROL—Same as foregoing species.

APPLE LEAF APHIS² (*Aphis pomi* = *Aphis mali*)

Order—Hemiptera

The leaf-aphid resembles the grain aphid; it has only recently made its appearance in this country (1897) coming from Europe but is already widely distributed; the males are wingless; it is considered one of the most injurious forms.

Winters as eggs on tree; wingless and winged generations produced throughout summer on apple leaves; eggs laid in late fall; probably most injurious aphid.

CONTROL—Same as foregoing species.

THE FALL CANKER-WORM³ (*Alsophila pometaria*)

Order—Lepidoptera. Manual p. 276

Moths emerge in late fall and the wingless females lay their eggs in large clusters on bark; eggs rest over winter and hatch in early May; larvæ which are loopers and have only 3 pairs of abdominal legs feed for a month

¹Quaintance—U. S. Bu. Ent., Circ. 81.

²Quaintance—U. S. Bu. Ent., Circ. 81.

³Coquillett—U. S. Bu. Ent. Circ. 9.

and in June and July go into the ground to change to pupæ in dense cocoons, and remain here until fall when the moths appear again; one brood a year.

THE SPRING CANKER-WORM¹ (*Paleacrita vernata*)

Order—Lepidoptera. Manual p. 275

Moths emerge in March and April and lay their eggs in small clusters in crevices of the bark; caterpillars which are loopers and have only 2 pairs of abdominal legs hatch in May and in June and July go into the ground where they remain as pupæ until the next spring; one brood a year; the female is wingless and bears several transverse rows of short spines on her abdomen; the spring canker-worm is usually the common one in New York.

CONTROL—Caterpillars quite resistant to poisons, yet arsenate of lead, 6 to 10 pounds to 100 gallons water will control them; also bands of sticky material, like tar, tanglefoot or printers' ink to prevent the females from climbing trees to lay eggs; bands of fluffy cotton batting will serve; apply in October for fall canker-worm and in early spring for spring canker-worm; also plow and cultivate in August or September to destroy the pupæ in the soil.

THE APPLE TENT-CATERPILLAR² (*Malacosoma americana*)

Order—Lepidoptera. Manual p. 360

Pass winter as eggs laid in rings around branches; hatch early and larvæ build tents in crotches of branches; when grown they make dense cocoons in secluded places and in about 2 weeks the moths appear and soon deposit eggs.

CONTROL—Collect and burn egg masses; school children are often enlisted in the work of collecting the egg masses and thousands of the egg-rings are destroyed; spray infested trees with arsenate of lead 2 pounds to 50 gallons of water just as the buds begin to open; repeat in a week

¹Quaintance—U. S. Bu. Ent. Bull. 68, Pt. II.

²Quaintance—U. S. Bu. Ent., Circ. 98.

if necessary; destroy wild cherry and seedling apple trees along the fence rows.

THE FOREST TENT-CATERPILLAR¹ (*Malacosoma disstria*)

Order—Lepidoptera. Manual p. 362

Life history is similar to former species; larvæ do not build tent.

CONTROL—In addition to above use the jarring method.

WHITE-MARKED TUSSOCK MOTH² (*Hemerocampa leucostigma*)

Order—Lepidoptera. Manual p. 310

Lay eggs in July on cocoons and cover them with a white frothy substance; remain here all winter and hatch latter part of May; the caterpillar has two long pencils of hairs just back of the head, a similar tuft on the posterior end of the body, and four tufts of short white hairs on the back; they feed on leaves and fruit for four weeks and then pupate in cocoons for 10 to 14 days; the adult wingless female deposits eggs on cocoons; male is winged.

CONTROL—Collect egg clusters; spray with arsenate of lead 3 pounds to 50 gallons; jar trees for caterpillars; band trees for larvæ.

THE APPLE MAGGOT³ (*Rhagoletis pomonella*)

Order—Diptera

Eggs laid beneath skin of apple; small white maggots tunnel all through fruit; finally, when apple falls they go into ground and pupate. A second brood may appear about September 1st; the insects pass the winter as pupæ in the soil beneath the trees; flies appear latter part of June.

CONTROL—Spray infested trees the first week in July with arsenate of lead, 2 pounds in 50 gallons with a gallon

¹Slingerland—Cornell Bull. 170.

²Schoene—Geneva Bull. 312.

³Illingworth—Cornell Bull. 324.

of cheap molasses added to sweeten it; repeat twice ten days apart on badly infested trees; renew after a rain. Evidence seems to indicate that the ordinary spraying of orchards with arsenate of lead and without sweetening will control this pest if the spraying is done thoroughly each year.

THE RIBBED COCOON MAKER¹ (*Bucculatrix pomifoliella*)

Order—Lepidoptera. Manual p. 253

In the middle of September larvæ creep to branches and make white, ribbed, winter cases and change to pupæ; in May the moths appear and soon lay their eggs on under sides of leaves; they hatch in a week or 10 days and mine into leaves; they feed for 8 or 10 days and then emerge from the leaf and make a molting cocoon, molt again in 5 or 6 days, then feed again for a week and then spin true cocoons; two broods here.

CONTROL—Spray in March with lime-sulfur at scale strengths; spray in June with arsenate of lead $2\frac{1}{2}$ pounds to 50 gallons.

OYSTER-SHELL BARK LOUSE² (*Lepidosaphes ulmi*)

Order—Hemiptera

They pass winter as whitish eggs underneath the brown, elongated, oyster-shell like scales on the bark of the tree; eggs hatch in May and June and the young soon settle and secrete their own scale; probably one generation a year in New York.

CONTROL—Spraying with lime-sulfur at scale strengths (1 to 8) for 3 or 4 successive seasons usually holds this pest in check. Spray for young as they hatch in May or June with "black leaf 40", $\frac{3}{4}$ pint to 100 gallons water with 4 pounds of soap added or with 10% kerosene emulsion.

¹Slingerland—Cornell Bull. 214.

²Quaintance—U. S. Bu. Ent. Circ. 121.

THE WOOLLY APHIS¹ (*Schizoneura lanigera*)

Order—Hemiptera. Manual p. 162

It is of American origin and became noticeable here about 1850; most serious on the apple; there are two forms, the trunk form and the root form; the trunk form occurs on lower limbs, trunk, and water sprouts. It causes scars on limbs but is not considered to be seriously injurious; the root form is very injurious to young apple trees when present on the roots; it causes swellings on roots and the roots finally decay and trees die; both forms secrete a white cottony secretion hence the name, woolly aphid. This pest of the apple is more serious farther south than in New York.

The woolly aphid has a complicated life history. Some of the winged forms on apple in autumn fly to elm trees where the true females are produced, each of which lays an egg in a crevice of the bark where it passes the winter and hatches in the spring. The aphids multiply in the elm and cause the leaves to curl. Finally some of the winged forms may fly back to the apple. In the meantime the aphid has maintained its foothold on the apple tree.

CONTROL—The trunk forms may be controlled with kerosene emulsion 15%. The root form may be controlled with 15% kerosene emulsion. The earth should be removed about each tree to the depth of 3 or 4 inches over a circle with a diameter of 4 feet; then soak the soil with the emulsion and hoe dirt back; do this in late spring when tree is in leaf.

RED BUGS² (*Heterocordylus malinus*)(*Lygidea mendax*)

Order—Hemiptera

There are two species of red bugs that injure the fruit by puncturing it which causes it to fall off or become knotty; the life histories of both are quite similar; the

¹Marlatt—U. S. Bu. Ent. Circ. 20.²Crosby—Cornell Bull. 291.

eggs of both are laid during late June or early July in the bark of the smaller branches; they hatch the next spring soon after the leaves of the fruit buds open and the nymphs feed upon the leaves and fruits. Greenings, pound sweets and spies most subject to attack.

CONTROL—Spray for the nymphs with "black leaf 40", 1 pint to 100 gallons of water; the efficiency will be increased by adding 4 pounds of soap to every 100 gallons; spray just before blossoms open and after they fall if necessary.

APPLE-SEED CHALCIS¹ (*Syntomaspis druparum*)

Order—Hymenoptera

The adult wasp-like fly punctures the fruit to deposit her eggs in the seed and this causes the fruit to become knotty; the egg is deposited inside of an apple seed in June; it hatches and the grub feeds on the soft kernel until September; it then hibernates in the hollow seed shell until spring when the adults appear; particularly injurious to early apples.

CONTROL—Since the grub lives over winter in the seeds the apples under the tree should all be collected and destroyed.

THE GREEN FRUIT WORMS² (*Xylinia antennata*) (*Xylinia laticinerea*)

Order—Lepidoptera

In some seasons the larvæ of several species of noctuid moths, attack apples and eat large holes in the sides of the fruit; these larvæ have become known as the green fruit worms; the larvæ appear in great numbers in May and June and do their damage, then go into the soil to the depth of 1 to 3 inches where they make an earthen cell and spin a thin cocoon and change to pupæ; there they remain until September when the moths appear and pass the winter in sheltered nooks; some of the pupæ remain all winter in the soil. The moths come from

¹Crosby—Cornell Bull. 265.

²Slingerland—Cornell Bull. 123.

their hibernating quarters or from the soil in March and April and lay their nearly globular, ridged eggs singly on the apple and pear branches. The larvæ are not noticed until they become half grown and are then hard to kill.

CONTROL—If the trees are known to be infested they should be sprayed just as the tips of the buds show green and again just before the blossoms open with arsenate of lead, 3 pounds to 50 gallons of water or lime-sulfur.

THE PEAR-LEAF BLISTER-MITE¹ (*Eriophyes pyri*)

Order—Acarina

This mite has become a serious pest of apple trees in New York State within the last few years; it is fully discussed under pear pests.

FRUIT-TREE LEAF-ROLLER² (*Archips argyrospila*)

Order—Lepidoptera

Eggs laid in small patches on branches of trees in June; larvæ hatch next spring and attack buds and roll leaves together and eat into sides of fruit; pupate in rolled leaves with a flimsy cocoon; moths appear in June and July and lay eggs in great numbers on the branches where they remain until the following spring. This insect is exceedingly injurious when once established in an orchard. It attacks apples, pears, cherries, and other fruits.

CONTROL—Spray the trees infested with eggs just before the buds start with a miscible oil, 1 gallon to 15 gallons of water. Follow this with arsenate of lead, 3 pounds to 50 gallons just as soon as the tips of the buds show green, and again before the blossoms open. The spraying should be done thoroughly.

APPLE CURCULIO³ (*Anthonomus quadrigibbus*)

Order—Coleoptera

Mainly injurious in Central States; eggs laid in fruit while small; larvæ feed on tissues of apple for three

¹Parrott—Geneva Bull. 283.

²Herrick—Cornell Bull. 311.

³Crandall—Illinois Bull. 98.

weeks; pupæ formed in apple and after about one week adult beetles emerge.

CONTROL—Spray with arsenate of lead, 3 pounds to 50 gallons just after petals fall and repeat in ten days; clean up old fences and hedgerows near orchard.

TRUMPET LEAF-MINER¹ (*Tischeria malifoliella*)

Order—Lepidoptera. Manual p. 249

Eggs laid on leaves; larvæ gnaw through egg directly into the leaf and begin making their trumpet-shaped mines in the leaves; four generations in latitude of Washington, probably two here; larvæ of last generation pass winter in mines in fallen leaves and pupate in spring.

CONTROL—Plow the leaves under or rake them and burn; spray infested leaves during June with "black-leaf-40," 1 pint to 100 gallons of water with 4 pounds of soap added.

FALL WEB-WORM² (*Hyphantria cunea*)

Order—Lepidoptera. Manual, p. 321

Eggs laid during June or July in clusters on leaves; larvæ build web nests all over trees; they pupate in September in flimsy cocoons hid away in cracks and crevices; in these the pupæ pass the winter, the moths appearing in May or June; farther south there are two broods.

CONTROL—Spray with arsenate of lead, 3 pounds to 50 gallons of water as soon as the young caterpillars are seen; collect cocoons during winter.

THE RED-HUMPED APPLE-WORM³ (*Schizura concinna*)

Order—Lepidoptera. Manual, p. 267

Eggs laid in large white clusters on leaves in July; larvæ feed in colonies on a branch; they pupate in ground

¹Quaintance—U. S. Bu. Ent. Bull. 68, Pt. III.

Jarvis—Conn. (Storrs) Bull. 45.

²Sanderson—New Hampshire Bull. 139.

³Sanderson—New Hampshire Bull. 139.

and lie there all winter; the moths emerge in June and July.

CONTROL—Burn caterpillars with rag torch or spray with arsenate of lead 3 pounds to 50 gallons.

YELLOW-NECKED CATERpillars¹ (*Datana ministra*)

Order—Lepidoptera. Manual, p. 265

Eggs laid in large white clusters in June and July; larvæ are gregarious and often occur in large clusters on single branches; pupate in the earth in August and September where they remain until the following spring; moths appear in June and July.

CONTROL—Same as for the red-humped caterpillars.

THE PALMER-WORM² (*Ypsolophus ligulellus*)

Order—Lepidoptera

This is an insect that appears occasionally in injurious numbers; the larvæ destroy foliage and eat into fruit during June; moths appear first part of July and evidently live over winter until following spring; eggs laid mostly on undersides of leaves.

CONTROL—Spray with arsenate of lead 2 pounds to 50 gallons when petals have three-fourths dropped and again in three weeks.

BUFFALO TREE-HOPPER³ (*Ceresa bubalus*)

Order—Hemiptera

Eggs laid in July and August in slits made in the bark of branches; characteristic oval scars are left; eggs hatch the following July; the nymphs feed on succulent weeds in orchard; branches of affected trees become weakened and break off.

CONTROL—Clean culture in and about the orchard to starve nymphs; careful and judicious pruning of infested branches.

¹Sanderson—New Hampshire Bull. 139.

²Slingerland—Cornell Bull. 187.

³Hodgkiss—Geneva Tech. Bull. 17.

THE PLUM CURCULIO—An important enemy to the apple. It causes knotty, scarred fruit and is apparently increasing as a pest to the apple. See plum pests for full discussion.

OTHER INSECTS INJURIOUS TO THE APPLE

The apple weevil (*Pseudanthrenus cratægi*).

The fringed-wing apple bud-moth (*Holcocera maligemella*).

The apple bud-worm (*Exartema malanum*).

The oblique banded leaf-roller (*Archips rosaceana*).

The leaf-crumpler (*Mineola indigenella*).

The lime-tree span-worm (*Erannis tiliaria*).

Bruce's measuring-worm (*Rachela bruceata*).

The gipsy moth (*Porthetria dispar*).

The brown-tail moth (*Euproctis chrysorrhæa*).

✓ The apple leaf-hopper (*Empoasca mali*).

The bronze apple-tree weevil (*Magdalis ænescens*).

PLUM PESTS

At least 50 species of insects may feed upon the plum tree and its fruit.

THE PLUM CURCULIO¹ (*Conotrachelus nenuphar*)

Order—Coleoptera. Manual, p. 593

The adults hibernate in protected places along hedge-rows, fences, etc., and appear in spring; they feed upon fruit making shallow circular feeding punctures; they soon begin depositing eggs in the fruit, making a crescent-shaped cut beneath each egg; grubs hatch in 3 to 7 days and live in the fruit for about 20 days; the fruit usually falls to the ground and the grubs enter the soil from 1 to 3 inches and pupate; in July and August the adults appear and eat holes in the sides of apples, at least; these holes are usually surrounded by a dark ring of skin; beetles finally hibernate. This pest attacks apples, cherries, plums, pears.

¹Crandall—Ill. Bull. 98.

Quaintance and Jenne—U. S. Bu. Ent. Bull. 103.

CONTROL—Remove all fences, hedgerows, stone walls, etc., along sides of orchard; sunlight is fatal to larvæ, hence judicious pruning of trees and clean cultivation useful; cultivate orchards in July and August to kill pupæ; spray with arsenate of lead $2\frac{1}{2}$ pounds to 50 gallons of water just after petals fall and again ten days after.

PLUM SCALE¹ (*Lecanium corni*)

Order—Hemiptera.

Eggs are laid in May and June and hatch mainly in July; the young insects live on the leaves during the summer but migrate to the branches in the fall before the leaves drop; the young hibernate here but in the spring usually move to the smaller branches where they complete their growth by the latter part of May.

CONTROL—Spray young scales about July 1st with 10% kerosene emulsion or "black-leaf 40", 1 pint to 100 gallons of water with 4 pounds of soap added; spray young scales on branches just before buds burst with a miscible oil, 1 gallon to 15 gallons water.

THE PLUM GOUGER² (*Coccotorus scutellaris*)

Order—Coleoptera.

Occurs particularly in the Northern Mississippi Valley. Adults hibernate over winter and appear in early spring when they feed on buds and leaves; later make feeding punctures in fruit and finally deposit eggs in cavities dug in fruit; larvæ bore into pit and feed on kernel; change to pupae in pits and beetles emerge in August and September; principal injury caused by punctures made by beetles in feeding and egg-laying.

CONTROL—Probably thorough spraying with arsenate of lead will be effective. The first application should be made just before the blossoms open.

¹Slingerland—Cornell Bull. 83.

²Cooley—Mon. Bull. 62.

OTHER INSECTS INJURIOUS TO THE PLUM

Plum leaf-miner (*Nepticula slingerlandella*).
American plum-borer (*Euzophera semifuneralis*).
Plum web-spinning sawfly (*Neurotoma inconspicua*).
Plum plant-louse (*Myzus mahaleb*).
Rusty brown plum aphid (*Aphis setaræ*).
Mealy plum louse (*Hyalopterus arundinis*).
European fruit-tree scale (*Aspidiotus ostreæformis*).

PEAR PESTS

THE PEAR-LEAF BLISTER-MITE¹ (*Eriophyes pyri*)

Order—Acarina

This is an European pest originally confined to the pear but now an important pest on apple in New York; it is a small, light-colored, four-legged animal about 1-125 of an inch in length; it hibernates in the buds beneath the bud-scales; in the spring the mites become active and go to the unfolding leaves into which they burrow and make small brown, almost black, galls or blisters on them; the mites live inside the galls in the tissues of the leaves and lay their eggs there; the young are produced in the galls but emerge later and form other blisters; affected leaves turn yellow and drop, thus injuring the tree.

CONTROL—Spray trees in fall or spring with lime-sulfur, 1 gallon to 10 or 12 of water.

THE PEAR PSYLLA² (*Psylla pyricola*)

Order—Hemiptera. Manual, p. 156

A very fluctuating pest introduced from Europe upon young pear trees about 1832; very injurious in central and western New York and along the Hudson; the orange-yellow eggs are deposited in creases in the bark mostly before the buds burst; the eggs hatch usually during the first two weeks of May; the nymphs suck juices from leaves and stems of young fruit; they secrete great

¹Parrott—Geneva Bull. 306.

²Slingerland—Cornell Bull. 44.

Hodgkiss—Geneva Bull. 387.

quantities of honey-dew in which a fungus thrives and forms a black coating all over the branches; the nymphs mature in about one month and the adults appear; there may be four broods in a season; the adults of the last brood winter over in the crevices of the bark.

CONTROL—Scrape rough bark from trees and spray in November or December or March or early April with "black leaf 40," $\frac{3}{4}$ pint to 100 gallons and 5 pounds of soap; miscible oil may also be used at the rate of 1 gallon to 15 of water; spray on warm days when the temperature is not freezing; spray last of April or early May as buds are bursting with lime-sulfur at winter strengths to kill eggs. Spray for nymphs with "black-leaf 40," $\frac{3}{4}$ pint to 100 gallons with 5 pounds of soap; practice clean culture.

THE PEAR SLUG¹ (*Eriocampoides limacina*)

Order—Hymenoptera

Eggs laid in June in the leaf, hatch in 2 weeks and the slugs become full-grown in 4 or 5 weeks, when they shed their green skin for a yellow one and go into ground to pupate; the flies emerge in about 2 weeks; two broods, first in June and second in August; hibernate as contracted slugs in their cocoons in soil.

CONTROL—Spray with arsenate of lead, 2 pounds to 50 gallons of water.

THE SAN JOSE SCALE² (*Aspidiotus perniciosus*)

Order—Hemiptera

One of our worst pests on fruit trees; first established in this country at San José, Calif.; widely distributed over the United States and infests apple, peach, pear, plum, currant, etc.; first described by Professor Comstock in 1880; first discovered in the eastern United States in 1893; its original home is in China. The insects pass the winter in an immature form—three-

¹Marlatt—U. S. Bu. Ent., Circ. 26.

²Quaintance—U. S. Bu. Ent. Circ. 124.

Britton—Conn. Bull. 165.

fourths grown—on the branches of infested trees under small, circular, almost black scales; young are born in the spring, in June, for first generation; there may be four or five generations during a season.

CONTROL—Spray with lime-sulfur, fall and spring; spray old rough-barked trees with one application of 25% oil emulsion; summer strengths of lime-sulfur are effective when young are hatching.

THE SCURFY BARK-LOUSE¹ (*Chionaspis furfura*)

Order—Hemiptera

The female scales are large, elongated and dirty white; the male scales are small, long and narrow and have three ridges running lengthwise; the female matures toward fall and lays 60 to 80 purplish eggs beneath the scale which remain there until the following spring; the female gradually shrivels and dies as she lays her eggs; there is one brood a year; this pest occurs on apple as well as pear but it is not considered seriously injurious.

CONTROL—Spray when the eggs are hatching and the young are appearing with "black leaf 40," 1 pint to 100 gallons of water with 4 pounds of soap, or with whale-oil soap, 1 pound in 5 gallons of water.

THE PEAR MIDGE² (*Contarinia pyrivora*)

Order—Diptera

The adult insects which resemble miniature mosquitoes, and are related to the Hessian fly, appear in the spring when the buds are bursting and lay their eggs through the petals and calyx on the anthers of the unopened flowers; eggs hatch in 4 or 5 days; the maggots work their way to the core of the developing pear and eat into the flesh in all directions; they cause the fruit to become misshapen; when the maggots are full-grown, about June 1st, the pears crack open and allow them to escape to the ground, where they change to pupæ and remain

¹Quaintance and Sasser—U. S. Bu. Ent., Circ. 121.

²Smith—N. J. Bull. 99.

in the ground all winter; one brood a year; now occurs in Connecticut, New York and New Jersey, being confined to the Hudson River Valley in New York.

CONTROL—Pick and destroy all misshapen infested fruits before May 15th; use kainit, one-half ton per acre.

THE PEAR THRIPS¹ (*Euthrips pyri*)

Order—Thysanoptera

The thrips was first discovered in California where it has caused much injury; it was first discovered in New York in the Hudson River Valley in 1911 although probably had been present there for some years before; the thrips pass the fall and winter in the soil and the adults appear in the spring; they injure the opening buds and lay their eggs in the tissues of the fruit stems and leaves; the larvæ feed mainly on the young leaves; after feeding about two weeks they go into the ground but do not change to pupæ until about October.

CONTROL—Spray swelling, partly open and fully opened buds with "black leaf 40," $\frac{3}{4}$ pint to 100 gallons water and 5 pounds soap; spray on successive days or every few days until probably 2 or 3 applications have been made.

THE SINUATE PEAR BORER² (*Agrilus sinuatus*)

Order—Coleoptera

First discovered in New Jersey in 1894; now seriously injurious in lower Hudson Valley; the female deposits her eggs in crevices of the bark or under the bark scales; these hatch in early July and the slender whitish grubs make winding burrows in the sapwood; the larva rests during the winter but the next year it makes larger and more winding burrows which frequently cut off the supply of sap and kill the tree; the larva passes another winter in the tree changing to a pupa in the following spring; the slender bronze-brown beetles emerge the last of May and during June.

¹Parrott—Geneva Bull. 343.

²Smith—15th Ann. Rept. N. J. Agri. Expt. Station.

CONTROL—Adults feed on leaves which suggests spraying with arsenate of lead after the petals fall; the spraying should be continued during successive years.

THE FALSE TARNISHED PLANT-BUG¹ (*Lygus invitus*)

Order—Hemiptera

This insect has for years caused more or less injury to pears in New York State; the nymphs puncture the young fruit, thus causing it to become deformed and knotty; the tissue surrounding the puncture becomes hardened and gritty; the eggs are deposited in the young pear branches.

The adult is about $\frac{1}{4}$ inch in length, very similar to the tarnished plant-bug and is light brownish in color; the winter seems to be passed in the egg stage.

CONTROL—Spray about the time the petals are falling with "black leaf 40", $\frac{3}{4}$ pint to 100 gallons of water to which are added 3 or 4 pounds of soap. Repeat, if necessary a few days later.

OTHER INSECTS INJURIOUS TO THE PEAR

Pear-blight beetle (*Xyleborus dispar*).

Codling-moth (*Carpocapsa pomonella*).

Green fruit-worm (*Xylina antennata*).

San José scale (*Aspidiotus perniciosus*).

Cigar case-bearer (*Coleophora fletcherella*).

Howard scale (*Aspidiotus howardi*).

Fruit-tree leaf-roller (*Archips argyrospila*).

PEACH PESTS

At least 25 different insects attack the peach tree.

THE PEACH-TREE BORER² (*Sanninoidea exitiosa*)

Order—Lepidoptera. Manual, p. 260

This pest is found in every state where peaches are grown east of the Rocky Mountains; it is a native insect and may attack the cherry, plum, prune, apricot, almond, and nectarine.

¹Parrott and Hodgkiss—New York (Geneva) Bull. 368.

²Slingerland—Cornell Bull. 176.

Smith—New Jersey Bull. 235.

The eggs are deposited on the bark of the trunks of trees in July and later; they hatch and the young larvæ find a crevice through which they gnaw their way into the inner bark; here they work in the inner bark and sapwood, usually just below the surface of the ground; they often girdle young trees; the borers become half or two-thirds grown by fall and hibernate, either in their burrows or in hibernacula until spring; they become active and complete their growth by first part of June in New York and transform to pupæ; some larvæ seem to live over another year; the larvæ make large cocoons at the surface of the ground and the moths emerge from latter part of June to August; the moths are clear-winged, shy and not often seen; the female has two orange-yellow bands on abdomen.

CONTROL—Dig out the borers before June 15th of each year; Smith says, after borers are dug, spray the trunks with lime-sulfur at winter strengths with an excess of lime added and with 1 pound arsenate of lead to 5 gallons of the mixture. Spray with force into crevices of bark and then hill up 6 inches around base of tree; gas tar is sometimes used but some danger in it. A mechanical protector made of roofing paper and placed about trunk of tree said to be very efficient.

THE BLACK PEACH APHIS¹ (*Aphis persicæ-niger*)

Order—Hemiptera

The full-grown aphids are black but the younger ones are reddish-yellow or amber in color; the lice appear early in the season and confine their attacks to the tender bark of the twigs; later they attack the blossoms and blight them; they also attack the young peaches causing them to wilt and drop; the leaves also curl; the aphids leave the branches in the latter part of June; they are said to pass the winter on the roots of the tree reinfesting the tree again in spring; this species often gets into this state on trees from nurseries in New Jersey, Maryland, etc.

¹Slingerland—Cornell Bull. 49, p. 325.

CONTROL—Require nursey stock to be fumigated or dip the roots after freeing them from dirt in 15% kerosene emulsion for 2 *minutes* only or in “black-leaf-40,” 1 ounce to 5 gallons.

THE FRUIT-TREE BARK-BEETLE¹ (*Eccoptogaster rugulosus*)

Order—Coleoptera

Peach, cherry, plum and apple trees are often found with many small, round holes in the bark of the trunks and branches, due to the attacks of this small black beetle about one-tenth of an inch long; when trees are first attacked masses of gum exude; diseased or weakened trees are most liable to attack but healthy trees are also subject to attack; the parent beetle bores through bark and excavates a burrow beneath, along the sides of which she digs tiny niches in each of which an egg is deposited; the eggs hatch and each grub excavates a long burrow as it grows but finally changes to a pupa and the adult emerges cutting a round hole in the bark; at least two generations a year; passes the winter as a larva; very injurious and hard to control; also called the shot-hole borer.

CONTROL—Maintain vigorous healthy trees by proper cultivation and fertilization; cut down and burn all trees beyond hope and cut off all badly infested branches from other trees; clean up hedgerows on the borders of orchards; apply thick coat of whitewash three times a year to protect trees, last of March, first part of July, and first of October.

THE PEACH-TREE BARK-BEETLE² (*Phlæotribus liminaris*)

Order—Coleoptera

This is another species very similar in appearance to the former, works in much the same way on peach trees but not so prevalent in New York; hibernates as adults in cells just beneath outer layer of bark on both healthy

¹Chittenden—U. S. Bu. Ent., Circ. 29.

²Wilson—U. S. Bu. Ent. Bull. 68, Pt. 9.

and unhealthy trees; in early spring they come out and migrate to trees, wood piles, brush heaps, etc., wherever they can build their brood chambers; 2 broods a year.

THE PEACH TWIG-BORER¹ (*Anarsia lineatella*)

Order—Lepidoptera

Apparently not a serious pest here; more serious farther south and in California; the half-grown larvæ hibernate in cells just under the outer bark, mainly in crotches of the branches; in the spring the larvæ emerge and attack the new leaf shoots into which they burrow; there are several broods a season some of which attack the stems of the fruit and some the fruit itself; the last brood of larvæ go into hibernation in cells in the bark; the moth is only a little over half an inch in expanse of wings and of a dark grey color.

CONTROL—Lime-sulfur 1 to 10 and 1 to 11 applied in the spring after the buds have begun to swell seems effective in California and Colorado; also arsenate of lead, 5 pounds to 50 gallons, applied when the majority of the blossom buds are showing their pink tips seems effective in Colorado.

GREEN PEACH APHIS² (*Myzus persicæ*)

Order—Hemiptera

Described under a multitude of names; feeds on 60 different plants; most abundant peach louse; spends winter in egg stage on tree; eggs hatch in early spring and young go on the buds; the third generation leaves for other plants.

CONTROL—Spray with "black leaf 40," $\frac{3}{4}$ pint to 100 gallons of water with 4 pounds of soap or with whale-oil soap, 1 pound to 5 gallons or with 10% kerosene emulsion.

¹Marlatt—U. S. Farmers' Bull. 80.

Clarke—Calif. Bull. 144.

²Gillette—Colo. Bull. 133.

THE PEACH LECANIUM¹ (*Lecanium nigrofasciatum*)

Order—Hemiptera

The "Terrapin scale" affects peach, plum, apple, maple, sycamore, linden, and birch; it winters as a nearly grown female on the branches; these mature early in spring and lay eggs; the young continue their growth slowly until fall when they hibernate; only one generation a year; this insect is apparently not abundant in New York; affected trees take on a sooty appearance due to a black fungus that flourishes in the honey-dew excreted by the insects.

CONTROL—Lime-sulfur is not effective; kerosene emulsion 20 to 25% applied just before buds burst will kill the hibernating females; the miscible oils 1 to 15 just before the buds burst are effective and can be applied to everything except peach; probably "black leaf 40," 1 pint to 100 gallons of water, with 4 pounds of soap applied when the young are just appearing from the eggs will be effective.

THE TARNISHED PLANT-BUG² (*Lygus pratensis*)

Order—Hemiptera

This widespread bug evidently attacks the fruit of peaches in some years puncturing the epidermis and scarring the surface of the fruits; as a result gum exudes and the peaches soon become unfit for the market; the bug evidently attacks mostly peaches on trees standing in uncultivated orchards or about the edges of orchards among grass and weeds; it is very injurious to young peach trees in the nursery row; it punctures the buds and tender growing tips thus producing a stunted straggling young tree; it also attacks apples causing dimples in them.

The adult is a dull yellowish or greenish bug mottled with reddish-brown and about one-fifth inch in length; the eggs are inserted in the tender tips or petioles and veins

¹Sanders—U. S. Bu. Ent. Circ. 88.

²Crosby and Leonard—Cornell Bull. 346.

of leaves; the life cycle is probably about 45 days and there are probably several generations a year.

CONTROL—Clean cultivation is the only known method of control.

THE PLUM CURCULIO¹—An important pest on peaches because it not only punctures the fruit but carries the spores of brown-rot and makes wounds through which the brown-rot enters. The self-boiled lime-sulfur for control of brown-rot with arsenate of lead added at the rate of 2 pounds to 50 gallons of the mixture has given good results in the control of these pests. The arsenate of lead combined with the self-boiled lime-sulfur does not seem to be as injurious to peaches as when used alone. The first application should be made about the time the calyces or shucks are falling and the second two or three weeks later. It is doubtful if a third application of poison is advisable.

THE SAN JOSE SCALE—Very injurious to peach trees; discussed under pear pests.

OTHER INSECTS INJURIOUS TO THE PEACH

Lesser peach-tree borer (*Sesia pictipes*).

White peach scale (*Aulacaspis pentagona*).

San José scale (*Aspidiotus perniciosus*).

Fruit-tree leaf-roller (*Archips argyrospila*).

Apple-tree tent-caterpillar (*Malacosoma americana*).

Peach saw-fly (*Pamphilius persicus*).

QUINCE PESTS

THE QUINCE CURCULIO² (*Conotrachelus crataegi*)

Order—Coleoptera

This insect is a native one and its natural food is the hawthorn; it also attacks pears and is widely distributed throughout the eastern, central, and extreme western portions of the United States.

¹Scott and Quaintance—U. S. Bu. Ent. Circ. 120.

²Slingerland—Cornell Bull. 148.

The winter is passed in the grub stage in small cells 2 or 3 inches below the surface of the earth; the grubs change to pupæ in the spring; the beetles appear from last week in May in some seasons to last week in July in others; the beetles feed on young fruits for some days and then deposit their eggs in the fruit; the larvæ feed on the tissues of the quinces and when full-grown emerge through a hole and drop to the ground.

CONTROL—No good method of control known; jarring of trees recommended; also spraying trees just after blossoms fall and again in 10 days.

THE BUD MOTH—This is also quite a pest of quinces; discussed under apple pests.

THE PEAR SLUG—This occurs on quince trees but may be controlled as recommended under pear pests.

THE CODLING MOTH—This common apple pest is often quite a serious pest in quinces; it can doubtless be controlled as on apples.

THE ROUND-HEADED APPLE-BORER—This is seriously injurious to quince trees but is subject to the same methods of control as on the apple.

CHERRY PESTS

As many as 46 different pests may attack the cherry tree.

THE BLACK CHERRY LOUSE¹ (*Myzus cerasi*)

Order—Hemiptera

This is an old European pest and has been here for at least 50 years; the young lice appear about the first of June on sprouts and lower limbs of trees; the lice increase all through June until sometimes they become very abundant; then they seem to disappear, only scattered colonies remaining here and there; in September winged forms again appear; the cherry foliage may sometimes

¹Gillette—Colo. Bull. 133, p. 42.

be blackened with these lice; the winged and wingless forms are deep shining black and the body is rather broad and flat; they curl leaves badly.

CONTROL—Spray with “black leaf 40,” $\frac{3}{4}$ pint to 100 gallons of water with 4 pounds of soap added before leaves curl; spray thoroughly.

THE CHERRY FRUIT-FLIES¹ (*Rhagoletis cingulata*)
(*Rhagoletis fausta*)

Order—Diptera

These flies are very similar in appearance to the apple maggot fly; the eggs are inserted beneath the skin of the cherries just about the time they begin to redden; infested cherries do not show any effects of the egg laying or of the maggot within for some days; when cherries are left on tree or picked a portion of each fruit will rot and sink in on the side; the maggot is yellowish-white and a little over a quarter of an inch long; it is straight while the larva of the curculio that lives in cherries is usually more or less curved; the maggots leave the fruit when full-grown and enter the ground where they change to pupæ and remain until the following spring; there is only one brood a year; the insects seem to attack all varieties of cherries whether sweet or sour, early or late.

CONTROL—Spray with arsenate of lead, 5 pounds, water 100 gallons, and 3 gallons of molasses; apply just as cherries begin to redden or when flies first appear; only a quart or two of the mixture to a tree is needed; if it rains repeat in a week or ten days. There is evidence to show that arsenate of lead alone in water will control this insect.

THE CHERRY-TREE LEAF-ROLLER² (*Archips cerasivorana*)

Order—Lepidoptera

This pest is often seen on choke cherries; the eggs are laid in patches on trunks or branches near the ground;

¹Slingerland—Cornell Bull. 172.

Illingworth—Cornell Bull. 325.

²Herrick—Cornell Bull. 311, p. 290.

they remain here unhatched until the following spring; when they hatch the green larvæ crawl up to the branches where they begin to draw the leaves toward each other and tie them together with silk; in this way they build large ugly nests, inside of which they live and eat the leaves; the larvæ pupate in these nests and the moths appear in June and July; one brood a year.

CONTROL—Cut out nests and burn before moths appear.

CHERRY LEAF-MINER¹ (*Profenusa collaris*)

Order—Hymenoptera

The larvæ mine in the leaves of cherries; interior of leaves all eaten out and leaf then turns brown and a large "blister" is formed; principal damage occurs during last week of May and early part of June; the larvæ go into ground to hibernate.

CONTROL—Plow and cultivate ground in late fall to destroy larvæ.

SHOT-HOLE BORER—Discussed under peach pests. It is often a serious pest on cherries.

THE PEAR SLUG—Often a serious pest on cherries; discussed under pear pests.

THE PLUM CURCULIO—Often a serious pest on cherries; discussed under plum pests.

CONTROL—Spray sour cherries with arsenate of lead, 3 pounds to 50 gallons just after petals fall as the young cherries are bursting through the calyces; sweet cherries may need to be sprayed twice, ten days apart.

OTHER INSECTS INJURIOUS TO THE CHERRY

Cherry fruit-sawfly (*Hoplocampa cookei*).

Forbes' scale (*Aspidiotus forbesi*).

Fruit-tree leaf-roller (*Archips argyrospila*).

Oblique banded leaf-roller (*Archips rosaceana*).

¹Parrott—Proc. W. N. Y. Hort. Soc. for 1912, p. 122.

INSECTS INJURIOUS TO SMALL FRUITS

GRAPE PESTS

Over 100 insects recorded in this country on the vine.

THE GRAPE PHYLLOXERA¹ (*Phylloxera vastatrix*)

Order—Hemiptera

This insect has always existed in this country on wild vines but not very injurious here; very destructive in France; it exists in two forms, one on the leaves and one on the roots; the root form is much the more injurious one.

The true sexual eggs are laid in the fall on old wood and hatch the following spring; the young lice go to the leaves and form galls on the lower sides; in these galls a female may lay 500 or 600 eggs; there may be 6 or 7 generations a season on the leaves; in fall young pass to roots and winter there; the root-forms cause galls on the roots and great injury; winged females issue from cracks in the soil in fall of second year and go to the stems of vines where they lay 2 to 8 eggs; these eggs are of two sizes the smaller yielding males and the larger females; the true females are small with rudimentary mouthparts and each one lays a single true egg.

CONTROL—In France they use American root-stocks.

THE GRAPE ROOT-WORM² (*Fidia viticida*)

Order—Coleoptera

The most serious pest of the grape in this state; probably invaded Chautauqua grape region about 1899; it is an American insect and widely distributed over the northern half of the eastern United States.

The adult beetles appear last of June or first of July and begin feeding on leaves making characteristic chain-

¹Marlatt—U. S. Farmers' Bull. 70.

Quayle—Calif. Bull. 192.

²Slingerland—Cornell Bull. 184.

Hammar—U. S. Bu. Ent. Bull. 89.

Hartzell—Geneva Bull. 331.

like holes; about middle of July they begin to deposit eggs in masses under the loose bark on the canes and trunks; the eggs hatch in about two weeks and the larvæ drop to the ground where they make their way to the roots through cracks and crevices of the soil; they live upon the roots and become nearly and sometimes full-grown by fall; in November the larvæ burrow to a depth of a foot, form cells in the soil and pass the winter; in early May they return to the roots, feed a short time and change to pupæ along in the middle of June; the partly grown larvæ may feed longer; the pupal stage lasts about two weeks when the adults appear, thus completing the life history; one generation a year.

CONTROL—Cultivation about the roots of the vines with a horse-hoe during the first two weeks of June is of benefit in destroying the pupæ. If beetles are only moderately abundant, spray vines within one week after beetles first seen with 6 pounds of arsenate of lead in 100 gallons Bordeaux; if beetles abundant, use the sweetened mixture of six pounds arsenate of lead, 100 gallons water and 2 gallons molasses; rains will wash this mixture off and it must be repeated to be effective.

THE GRAPE-VINE FLEA-BEETLE¹ (*Haltica chalybea*)

Order—Coleoptera

Another American pest of grapes that in many years is very serious; the first pest, usually, to appear in the spring on grapes; widely distributed over the eastern United States.

The adult steel-blue beetles appear early and attack the swelling buds which they may completely destroy; when leaves appear they feed on them; the beetles lay their eggs all through May under the bark on the canes, under the scales surrounding the buds and occasionally on the leaves; eggs hatch latter part of June or early July; the larvæ then feed on foliage and attain their growth in about three weeks; they then drop to the

¹Slingerland—Cornell Bull. 157.
Hartzell—Geneva Bull. 331.

ground and burrow downward several inches where they form cells and change to pupæ; the pupal stage lasts 10 days to two weeks; the beetles emerge and feed upon the foliage but do little damage; they finally enter hibernation along hedgerows, borders of woods, etc., where they pass the winter.

CONTROL—Collect adults in pans with a shallow layer of kerosene in bottom; it is as economical as spraying vines; if no rains, spray vines, when beetles begin to appear, with arsenate of lead, 6 pounds water, 100 gallons and molasses, 2 gallons; later spray vines with arsenate of lead 3 pounds in 50 gallons of water or Bordeaux mixture.

THE ROSE-CHAFER¹ (*Macrodactylus subspinosus*)

Order—Coleoptera

This is an American insect and is injurious to grapes, cherries, apples, raspberries, roses and other plants; a very serious pest on grapes but is liable to occur locally; the adult beetles feed on the blossoms and when these are gone, on the leaves and berries.

The adult beetles appear during the latter half of June, mate, and deposit their eggs the last of June and through July; the eggs are deposited in sandy soil where they hatch and the white grubs feed on the roots of grasses; the grubs become full-grown by November and burrow down about one foot where they pass the winter; early in the spring they crawl back nearer the surface, feed for a time and change to pupæ during the latter part of May; in about three weeks the beetles appear. So far as observed these insects prefer sandy soil for breeding and develop largely in grass lands especially long-standing meadows.

CONTROL—Harrow the soil in which larvæ are present making three harrowings from the last week in May to the middle of June; spray vines with arsenate of lead, 8 pounds to 100 gallons with two gallon of molasses added; apply as soon as beetles first appear on the vines; it is said that a mixture of whale oil soap, 20 pounds, water,

¹Hartzell—Geneva Bull. 331.

100 gallons, and crude carbolic acid, 1 pint, will kill the beetles when hit and that this mixture will not injure apple and cherry foliage.

THE GRAPE LEAF-HOPPER¹ (*Typhlocyba comes*)

Order—Hemiptera

This leaf-hopper is often erroneously called "thrips"; it is an American insect and appears to be found wherever the grape grows; it is becoming of more importance but fluctuates in abundance and injuriousness; vines injured by the hoppers for several years have a stunted growth and bear few grapes.

The adults appear before the leaves have unfolded and feed until the middle of June when they begin to deposit their eggs within the tissues of the leaves; the eggs hatch during the first two weeks of July and the nymphs pass through five stages and many become adults by August 1st; they remain on vines until the autumn when they leave to find hibernating places; grassy ditch-banks, fence corners, hedgerows, and similar situations furnish hibernating opportunities; there is one full brood, a partial, and sometimes a full second brood; the nymphs live mostly on the under sides of the leaves.

CONTROL—Blackleaf extract, 1 to 100 to 150 is an efficient remedy. "Black leaf 40," 1 to 1000 to 1600 is also an efficient remedy. These mixtures must be sprayed on the under sides of the leaves to be effective. Use a large aperture in the nozzle and a pressure of 125 to 150 pounds.

THE GRAPE-BERRY MOTH² (*Polychrosis viteana*)

Order—Lepidoptera

Nearly all wormy grapes in New York are caused by the caterpillars of this moth; the moth is purplish-brown with not quite half an inch spread of wings; infested berries show a purplish spot on their green surfaces

¹Hartzell—Geneva Bull. 344.

Johnson—U. S. Bu. Ent. Bull. 97 Pt. I.

Slingerland—Cornell Bull. 215.

²Johnson & Hammar—Bull. 116, Part II, U. S. Bu. Ent.

and soon crack open at this place; spores of fungi enter and cause the berries to rot.

The insect spends the winter as a pupa in cocoons attached to the fallen leaves; moths begin to appear about June 1st and probably lay their eggs on the stems of the blossom clusters; the young caterpillars feed on the blossom buds, often slightly webbing them together; this spring brood of larvæ is hardly noticed by growers although they may destroy much setting fruit; the larvæ make cocoons on the leaves and the moths appear latter part of July; these moths lay eggs on the grape berries and these larvæ go into the berries and cause the wormy grapes; the larvæ mature in Sept. and make cocoons on the leaves; these fall to the ground where the pupæ pass the winter.

CONTROL—Spray just before blossoms open and again just after berries are set, making two applications, one immediately following the other with arsenate of lead at the rate of 6 pounds to 100 gallons of water.

THE GRAPE-BLOSSOM MIDGE¹ (*Contarinia johnsoni*)

Order—Diptera

This insect has been injurious in certain vineyards in Chautauqua County for several years; it is most injurious to early varieties; the larvæ live inside of the blossom buds and injure them by feeding upon the pistil; infested buds become much swollen and blasted.

Adults emerge from soil the latter part of May and deposit their eggs within the buds by means of a long telescopic ovipositor; the larvæ attain their growth a few days preceding blossoming and then crawl out of the bud; they drop to the ground and burrow beneath the surface where they form a cocoon and remain until the following spring when they change to pupæ.

CONTROL—No efficient method of control known.

¹Hartzell—Geneva Bull. 331.

THE GRAPE LEAF-FOLDER¹ (*Desmia funeralis*)

Order—Lepidoptera

In midsummer and later, many grape leaves may be found with the edges rolled or with the upper faces folded together; if opened a small active wriggling larva will be found between the folds; the leaf will also be found to be skeletonized inside of the folds.

The insect passes the winter as a pupa in the leaves; the moths appear early in the spring and there are at least two broods a season; the moth expands about one inch and has shining black wings bordered with white and with two white spots on each front one and one long white spot on each hind one.

CONTROL—Crush larvæ by hand in folded leaves; spray with arsenate of lead as for the berry moth and others.

THE STRIPED TREE-CRICKET² (*Oecanthus nigricornis*)

Order—Orthoptera

This species of *Oecanthus* often lays its eggs in canes of the grape causing a characteristic scarring of the canes. Its injuries, however, are not serious since the nymphs do not feed on the vines.

OTHER INSECTS INJURIOUS TO THE GRAPE

Grape-leaf skeletonizer (*Harrisina americana*).

Eight-spotted forester (*Alypia octomaculata*).

Grape plume-moth (*Oxyptilus periscelidactylus*).

Grape-cane borer (*Amphicerus bicaudatus*).

(*Schistocerus hamatus*).

Grape-cane gall-maker (*Ampelogypter sesostris*).

Cottony maple scale (*Pulvinaria vitis*).

Grape scale (*Aspidiotus uvæ*).

Apricot scale (*Eulecanium armeniacum*).

Grape curculio (*Craponius inæqualis*).

¹Quayle—California Bull. 192.

²Parrott and Fulton—Geneva (N. Y.) Bull. 388.

CURRANT PESTS

THE IMPORTED CURRANT WORM¹ (*Pteronus ribesii*)

Order—Hymenoptera. Manual, p. 613

An imported insect first found in New York about Rochester in 1857; it is a saw-fly with a reddish body about one-quarter of an inch long and four transparent wings. The adults appear soon after the leaves put out and lay their eggs along the veins of the undersides of the leaves; they hatch in a week or ten days; the larvæ have 10 pairs of legs and eat voraciously, often defoliating the bushes; when full-grown they are three-quarters of an inch long and burrow into the ground or hide beneath rubbish on the surface and spin cocoons within which they change to pupæ; in July the adults appear and deposit their eggs for a second generation which is often more abundant than the first; the larvæ of this second generation remain in the ground all winter.

CONTROL—Spray when larvæ are first seen with arsenate of lead, 3 pounds to 50 gallons of water; when berries begin to ripen use fresh white hellebore.

THE CURRANT-STEM GIRDLER² (*Janus integer*)

Order—Hymenoptera

An American insect that is widely distributed in New York State; in May, it girdles the new growth of the branches and the tips wilt and fall over; the adult insect is a saw-fly with a shining black body and transparent wings.

The winter is passed as a larva in burrows inside the currant stems; in April it changes to a pupa and in the last part of May the adults appear; the female makes a hole in the tender branch with her ovipositor and then deposits her egg; she then girdles the branch about one inch above the egg; this she does in an interesting way with her ovipositor; the end of the stem wilts and falls over; the larva burrows down the stem going 6 or 8

¹Riley—Ninth Rept., p. 7.²Slingerland—Cornell Bull. 126.

inches by fall; it then spins a cocoon at the lower end and passes the winter.

CONTROL—As soon as the wilted tips of the canes are seen in the spring they should be cut off 4 or 5 inches below the girdled place and burned. This will destroy all of the eggs.

THE CURRANT MOTH-BORER¹ (*Sesia tipuliformis*)

Order—Lepidoptera

This is a beautiful clear-winged moth like the peach-tree borer; it is another imported pest and is said to be, in some localities, a serious one.

The eggs are laid on the stems in the axils of the leaves; the young larva bores into the stem and gradually tunnels out a burrow down the center as it grows; the larvæ become half grown by fall and pass the winter in their burrows; in spring they complete their growth and pupate; the moths appear in June. Affected stems produce small yellowish leaves and are soon broken off by the wind.

CONTROL—Infested stems should be cut off below the lowest part of the tunnel and burned.

THE CURRANT APHIS² (*Myzus ribis*)

Order—Hemiptera

The small black eggs of this aphid are found on the stalks in winter and hatch just as the foliage appears; the aphids multiply and cause the foliage to curl and pucker; the life history through the summer is not well known; in late October the winged males and the true females appear and eggs are again deposited.

CONTROL—Spray before leaves are badly curled with "black leaf 40," 1 pint to 100 gallons of water with 4 pounds of soap added; spray the undersides of the leaves.

¹Lugger—Minn. Bull. 43, p. 184.

²Lowe—Geneva (N. Y.) Bull. 139.

THE FOUR-LINED LEAF-BUG¹ (*Pæcilopsus lineatus*)

Order—Hemiptera

This is a common bug with many food plants but is often very injurious to the young foliage of currant and gooseberry; attacked leaves turn brown, curl up and become brittle.

The eggs are deposited in slits cut lengthwise in the stems of the plants; they pass the winter in these situations and hatch early in the spring; the nymphs have shining vermilion red bodies; they molt five times and become full-grown in 17 to 20 days; the nymphs feed on the tenderest young foliage, causing brownish depressed spots to appear on the leaves; the adult bugs appear about the middle of June; lay their eggs, are active for about a month and then disappear.

CONTROL—Spray the nymphs with "black-leaf-40," three-fourths pint to 100 gallons of water; cut off tips of stems containing eggs and burn them.

OTHER INSECTS INJURIOUS TO THE CURRANT

Green currant worm (*Gymnonychus appendiculatus*).

Pepper-and-salt currant moth (*Lycia cognataria*).

Yellow currant fruit-fly (*Epochra canadensis*).

Dark currant fruit-fly (*Rhagoletis ribicola*).

San José scale (*Aspidiotus perniciosus*).

Walnut scale (*Aspidiotus juglans-regiæ*).

STRAWBERRY PESTS

WHITE GRUBS² (*Lachnosterna* spp.)

Order—Coleoptera

White grubs are the larvæ of May beetles or "June bugs"; there are at least eight species of these that are injurious; these insects have a prolonged life cycle, two to three years and may be longer in some cases; white grubs are liable to accumulate in old pastures and meadows and when these are broken and other crops

¹Slingerland—Cornell Bull. 58.

²Forbes—Illinois Bull. 116.

put on the sod there is liable to be much injury; the grubs eat off roots of strawberry plants.

The eggs are laid in balls of earth in the ground where they hatch and the grubs live there until the summer of the second year when they change to pupæ in the soil; the pupæ change to beetles in late summer but the beetles remain in their earthen cells until the following spring.

CONTROL—Do not follow sod land with strawberries; put some other crop between.

THE STRAWBERRY WEEVIL¹ (*Anthonomus signatus*)

Order—Coleoptera

This is a small beetle about one-tenth of an inch long with a rather long proboscis; it is usually more injurious farther south and in the southeastern part of New York State.

The weevils emerge from their winter quarters early and the females deposit their eggs within the buds of strawberries; the beetle then cuts off the flower-stem and the bud soon falls to the ground; the grub lives inside of the bud on the pollen and changes to a pupa from which the beetle emerges later; evidently but one brood a year.

CONTROL—If possible plant mostly pistillate varieties with just enough staminate varieties to cross-fertilize them; plant early-blooming staminate varieties as trap crops; cover beds with muslin; place beds in open fields away from fences, hedgerows, etc.; practice clean culture.

THE STRAWBERRY LEAF-ROLLER (*Ancylis comptana*)

Order—Lepidoptera

Moths appear in early May in New Jersey; lay pale green eggs mostly on the undersides of leaves; these hatch in about one week; the young larva feeds a day or two on upper side of the leaf but soon folds the halves of the leaf together, tying it securely with silk and lives within fully protected from insecticides; becomes full-grown in about

¹Chittenden—U. S. Bu. Ent., Circ. 21.

one month and is then about $\frac{1}{2}$ inch long, yellowish to greenish-brown and head shining brown; transforms to pupa in folded leaf; in New Jersey 3 broods a year but first brood causes most injury.

CONTROL—Make a thorough application of arsenate of lead, 5 pounds to 100 gallons of water, within a week after the first moths appear and before leaves are folded; burn over fields after crop is harvested; plow up old abandoned beds.

OTHER INSECTS INJURIOUS TO THE STRAWBERRY

Strawberry root-worm (*Typophorus canellus*).

Strawberry root-louse (*Aphis forbesi*).

Strawberry crown-moth (*Sesia rutilans*).

Green strawberry slug (*Empria ignota*).

Obsolete banded strawberry leaf-roller (*Archips obsoletana*).

Strawberry crown-girdler (*Otiorthynchus ovatus*).

Strawberry crown-borer (*Tyloderma fragariæ*).

RASPBERRY AND BLACKBERRY PESTS

THE RASPBERRY CANE-BORER¹ (*Oberea bimaculata*)

Order—Coleoptera

The adult beetle is about one-half an inch in length with a slender cylindrical body and long antennæ; the prothorax is yellow, generally with two or three black spots.

The beetles appear in June and deposit their eggs in the tender growth of the canes; the female then cuts two rings around the cane, one above and one below the egg; this causes the tips of the canes to wilt and fall over; the egg hatches and the young larva begins to bore downward in the center of the stem; it passes the first winter in its burrow not far from the egg and by the second fall reaches the root where it passes the winter, changes to a pupa in the spring and the beetle emerges in June; it has been said, however, that it takes but one year for the life history.

¹Comstock and Slingerland—Cornell Bull. 23.

CONTROL—Cut off the wilted tips of the canes some distance below the egg as they appear in June.

THE RASPBERRY SAW-FLY¹ (*Monophadnus rubi*)

Order—Hymenoptera

A saw-fly, the larvæ of which are at times quite injurious to raspberries; it may feed also upon the blackberry and dewberry; the leaves are completely devoured, the new canes may be injured and the buds and young fruit sometimes suffer.

The adults appear the first half of May and deposit their eggs within the tissues of the leaves from the undersides; in a week to ten days they hatch; the full-grown larva is green in color with the body covered with spine-bearing tubercles; after feeding on leaves until nothing but veins are left the larvæ go into the ground two or three inches below the surface and make a cocoon in which they spend the winter, changing to pupæ in the spring; there is only one brood annually.

CONTROL—The larvæ may be brushed from the plants to the ground where they will die; the plants may be sprayed with arsenate of lead, 2 pounds to 50 gallons of water as soon as the larvæ are seen.

THE STRIPED TREE-CRICKET² (*Oecanthus nigricornis*)

Order—Orthoptera

This insect lays its eggs in the canes in the fall where they remain all winter; the eggs are laid in rows and cause long jagged wounds in the canes; the nymphs and adults live largely on plant-lice and other insects and must be regarded as beneficial; the wounds made by depositing the eggs injure the canes.

CONTROL—If abundant, affected canes should be cut out in the fall and winter.

¹Lowe—Geneva Bull. 150.

²Parrott & Fulton—Geneva (N. Y.) Bull. 388.

THE RED-NECKED CANE-BORER¹ (*Agrilus ruficollis*)

Order—Coleoptera

The stems of raspberries sometimes bear irregular swellings or galls two or more inches in length and gradually tapering toward either end; caused by a beetle about one-third inch in length with reddish "neck" or thorax and black head; deposits egg in June in bark near base of a leaf on new growth; young larva bores upward in sapwood passing around stem in a spiral manner thus girdling cane; it is a flat yellowish-white grub about $\frac{3}{4}$ inch in length; completes growth in spring and changes to pupa in cell in pith.

CONTROL—Cut and burn infested canes during fall and winter; destroy wild berry bushes in which the beetles may breed.

THE RASPBERRY CANE-MAGGOT² (*Phorbia rubivora*)

Order—Diptera

This is a small fly that attacks the new shoots of the raspberry in the spring; the attacked shoots wilt and droop; the tip shrinks, turns dark blue and dies.

As soon as the new shoots appear in the spring the fly deposits its eggs in the axils of the tip leaves; the white maggot burrows to the pith of the stem and then begins to tunnel its way downward inside of the stem; after working downward a few inches it girdles the young shoot just beneath the bark which causes the tip to wilt; the maggot then tunnels farther downward until it reaches the surface of the ground; here it finally changes to a pupa in June and July; the pupa remains there until the following spring when the fly emerges; one brood a year.

CONTROL—As soon as the drooping canes are seen in the spring they should be cut off several inches below the girdle and burned.

¹Smith—N. J. State Rpt. (12th), p. 373.

²Slingerland—Cornell Bull. 126.

THE RASPBERRY ROOT-BORER¹ (*Bembecia marginata*)

Order—Lepidoptera

The adult moths are clear-winged and closely related to the peach-tree borer; the borer or larva is yellowish-white and 1 to 1½ inches long; they attack the stems and roots of raspberries and blackberries, causing the plants to die.

The moths appear in August and September and lay their brownish-red eggs on the lower side of the leaves; the larvæ crawl down the stems and burrow beneath the bark; they may hibernate at once or if early they will feed and grow some before winter; the next summer they bore into the stems and roots sometimes girdling the stem at the crown and attacking new shoots; during the next summer the larvæ become full-grown and pupate, the moths appearing in August and September.

CONTROL—The only way of controlling this pest is to pull up infested plants and burn them.

OTHER INSECTS INJURIOUS TO THE RASPBERRY

Raspberry horntail (*Hartigia abdominalis*).

Rose scale (*Aulacaspis rosæ*).

American raspberry beetle (*Byturus unicolor*).

Blackberry leaf-miner (*Metallus rubi*).

Red spider (*Tetranychus telarius*).

¹Smith—N. J. Bull. N, p. 9.

Lawrence—Washington Bull. 63.

INSECTS INJURIOUS TO VEGETABLES

WHITE POTATO

THE COLORADO POTATO BEETLE¹ (*Leptinotarsa 10-lineata*)

Order—Coleoptera. Manual, p. 576

First found on a wild plant (*Solanum*) of the potato family in Colorado in 1824; gradually spread eastward to Nebraska 1859, crossing the Mississippi River in 1864 and reaching New York 1872; moved at rate of 88 miles annually and reached the Atlantic in 1874; in 1877 it reached England but was exterminated.

The beetles winter over, usually deep in the ground, occasionally under rubbish; female lays her orange-red eggs in patches on the undersides of the leaves; she is capable of laying 500 to 1000; these hatch in 5 to 7 days; the grubs eat ravenously and mature in 2 or 3 weeks and then enter ground where they form cells and pupate; the pupal stage lasts 10 days to two weeks; there are two generations here, the adults of the second generation hibernating. The work of this beetle seems to affect quality of tubers.

CONTROL—Spray with paris green, 1 pound in 50 gallons of Bordeaux mixture or arsenite of zinc, 1½ pounds to 50 gallons.

THE POTATO FLEA-BEETLE² (*Epitrix cucumeris*)

Order—Coleoptera

The potato flea-beetle is a small beetle with enlarged muscular femora on the hind legs with which it jumps like fleas, hence the name.

The beetles hibernate in hedgerows, along fences, etc. and appear early in the spring; they bite holes in the epidermis of leaves and eat out green tissue; later in the season they cause much injury by their persistent feeding; the eggs are deposited on and in the soil around

¹Chittenden—U. S. Bu. Ent., Circ. 87.

²Johannsen—Maine Bull. 211.

the base of the plant and the small larvæ feed on the underground stems and tubers; they bore straight into the tubers and cause "slivers" in the potatoes; pimple-like spots often occur over the outside of the potato where these larvæ are situated and cause "pimplly" potatoes.

CONTROL—Thorough spraying with Bordeaux mixture to keep the plants covered is the only satisfactory method of control. Arsenate of lead may be added or paris green for the Colorado potato beetle.

BLISTER-BEETLE¹ (*Epicauta cinerea*)

Order—Coleoptera. Manual, p. 586.

This species is known as the "old-fashioned potato-bug"; it is a large, slender, beetle with soft, flexible elytra; these beetles pass through complicated changes in their life history; the eggs are laid on the earth and the young grubs feed upon the eggs of grasshoppers; the beetles often appear in great swarms over limited areas and are hard to control and quite destructive.

CONTROL—Hand-pick into pans of kerosene, spray with strong poison mixture, 3 pounds of arsenate of lead to 50 gallons of water.

THE POTATO STALK-BORER (*Trichobaris trinotata*)

Order—Coleoptera

This pest of the potato is more injurious in the West apparently than here although it is often injurious in New Jersey and may become so in New York at any time.

OTHER INSECTS INJURIOUS TO THE POTATO

Egg plant flea-beetle (*Epitrix fuscula*).

Tobacco flea-beetle (*Epitrix parvula*).

Potato tuber worm (*Phthorimæa operculella*).

Potato-scab gnat (*Epidapus scabiei*).

¹Gibson—42nd Ann. Rpt. Ent. Soc. Ont.

SWEET POTATO

THE SWEET POTATO FLEA-BEETLE (*Chætocnema confinis*)

Order—Coleoptera

A small bronze or brassy-brown shining beetle about one-sixteenth inch in length; hibernates over winter in rubbish appearing early in May in N. J.; egg unknown but larvae have been found on roots of bindweed and probably occur on roots of sweet potato; adult beetles injure potato vines by eating the leaves.

CONTROL—Dip leaves and stems of plants before setting in solution of arsenate of lead, 1 pound in 10 gallons of water; delay setting of plants as long as possible.

THE TWO-STRIPED SWEET POTATO BEETLE (*Cassida bivittata*)

Order—Coleoptera

Most abundant and injurious of all the "Gold-bugs"; less than $\frac{1}{4}$ inch in length and of a dull brownish-yellow color with a faint golden lustre; there are two black stripes on wing-covers; the eggs laid singly on under sides of leaves and each covered with a little black excrement; larva is dirty white and bears spines along sides of body; two long spines, the anal fork, at end of abdomen; these carry the cast skins over the back; pupa brown and retains the larval skins.

CONTROL—Dip plants as for flea-beetle and, in addition, spray in the field.

OTHER INSECTS INJURIOUS TO SWEET POTATOES

Golden tortoise beetle (*Coptocycla bicolor*).Black-legged tortoise beetle (*Cassida nigripes*).Sweet potato plume-moth (*Pterophorus monodactylus*).

Cutworms (Several species).

CABBAGE PESTS

THE CABBAGE ROOT-MAGGOT¹ (*Pegomya brassicæ*)

Order—Diptera

This pest is a small fly imported from Europe; it attacks cabbage, radishes, cauliflower, and other cruciferous plants; it also attacks cabbage plants in seed beds and causes much injury.

The flies appear early in the spring and deposit their eggs in crevices in the soil close to the stem of the plant; they hatch in a week or ten days and the young maggots immediately burrow along the surfaces of the young roots and later into the main roots; the maggots complete their growth in 3 to 4 weeks and pupate in the soil; they pass the winter as pupæ; probably three broods a season at least.

CONTROL—For seed plants in beds, screen the beds with muslin; for plants in the field, destroy all cabbage, radish, and turnip stumps, leaves and refuse; plow in fall to destroy puparia; use tarred papers on plants in field; use carbolic acid solution for radishes and plants in garden; hellebore, 1 ounce to 2 gallons of water seems to control the fly on radishes.

CUTWORMS ON CABBAGES² (Various species)

Order—Lepidoptera.

There are many kinds of cutworms all larvæ of noctuid moths; these larvæ attack various kinds of plants and cause a great amount of injury; they remain in the ground mostly during the day, work mostly at night, and attack the best plants.

The parent moths of the yellow-headed cutworm appear from late June through July and August; they deposit their eggs at the bases of grass stems where they hatch and the cutworms live on the roots of the grasses, attaining half their growth by fall; they then go downward

¹Slingerland—Cornell Bull. 78.²Schoene—Geneva Bulls. 301 and 334.³Herrick—Rural New Yorker, 1912, p. 618.

4 or 5 inches and make cells in which they pass the winter; in the spring they return to the surface, eat voraciously and complete their growth, pupating in the soil and changing to adults in July and August.

CONTROL—Do not follow sod with crops the cutworms attack; plow land in August and allow it to lie fallow until the following spring; use poison baits of bran, arsenic, paris green, and molasses; hand-pick, etc.

THE IMPORTED CABBAGE-WORM¹ (*Pontia rapæ*)

Order—Lepidoptera

This is the common white cabbage butterfly present all over the United States; it was imported from Europe and first appeared in Canada about 1856 or '57 and in New York about 1870; it feeds on nearly every cruciferous plant.

The butterflies appear in early spring and lay their eggs on the cabbage leaves; the eggs hatch in 4 to 8 days and the green velvety larvæ complete their growth in ten days to two weeks and change to chrysalids; this stage occupies one to two weeks in summer; the pupæ of the last brood in the fall remain over winter as such; there are three or four broods here. The insect has many parasites and diseases that aid in holding it in check.

CONTROL—Spray the plants with a poison mixture before heading is far advanced; in Hawaii 2 pounds paris green, 8 pounds whale-oil soap and 100 gallons of water have given good results; when plants are well headed one may use hellebore.

THE CABBAGE APHIS² (*Aphis brassicæ*)

Order—Homoptera

This is a plant-louse imported from Europe. It is covered with a whitish powdery secretion; it injures cabbages, cauliflower, turnips, etc.

¹Chittenden—U. S. Bu. Ent., Circ. 60.

²Herrick and Hungate—Cornell Bull. 300.

In autumn the true males and females appear and the latter deposit their dark brown eggs in great numbers on the cabbage leaves; in the early spring these hatch into the stem-mothers that live on the tender sprouts from the cabbage stumps; there is generation after generation of the winged and wingless aphids during the season until the true sexes are produced again in the fall; this aphid has many parasitic and predaceous enemies.

CONTROL—Destroy cabbage stumps and all refuse in the fall; spray plants with whale-oil soap or "black leaf 40," three-fourths of a pint to 100 gallons of water with 4 pounds of soap added.

THE CABBAGE LOOPER (*Autographa brassicæ*)

Order—Lepidoptera

A very injurious species on Long Island; it lacks some of the abdominal legs and therefore loops like a Geometrid; the white ribbed egg is deposited on the leaves; the larva at first is dark green with longitudinal white lines on sides of body; later it becomes pale green and lines disappear; the pupa is in a thin white cocoon in fold of leaf on under-side; apparently 3-brooded on Long Island; often injurious in greenhouses.

CONTROL—Same treatment as for other cabbage caterpillars but the looper is harder to hold in check

THE HARLEQUIN CABBAGE BUG (*Murgantia histrionica*)

Order—Hemiptera

A very destructive Southern cabbage pest which has gained a foothold on Long Island and is working northward in Ohio; lately been found near Elmira, N. Y.; lays its barrel-shaped eggs on leaves; several generations in a season.

CONTROL—Practice clean cultivation; plant early crop of mustard or radish as a trap crop and destroy the old bugs as they gather on this in the spring by spraying with pure kerosene and then by burning.

OTHER INSECTS INJURIOUS TO CABBAGE

Imported cabbage web-worm (*Hellula undalis*).
Diamond-back moth (*Plutella maculipennis*).
Cross-striped cabbage worm (*Evergestis rimosalis*).
Southern cabbage butterfly (*Pontia protodice*).
Flea-beetles (Various species).

ASPARAGUS PESTS

THE ASPARAGUS BEETLE¹ (*Crioceris asparagi*)

Order—Coleoptera

For two hundred years asparagus had no pests; now there are two beetles that work on it both being imported from Europe; the one here was first found in Queens County, New York, in 1862, but had probably been introduced about 1856.

The beetles hibernate under rubbish and appear in May; they lay their eggs on the stems of the asparagus where they hatch into soft grubs; these eat the plants and in ten days to two weeks attain their growth and go into the ground to pupate; in 5 to 8 days the adult beetles appear, the whole life cycle occupying 3 to 7 weeks; 2 or 3 broods a season here.

CONTROL—Hand-pick in small beds; cut down and destroy all volunteer plants in spring to force beetles to lay eggs on new shoots which are cut often; poison plants after cutting with arsenate of lead 2 pounds, and soap 4 pounds, to 50 gallons of water; clean up rubbish.

THE 12-SPOTTED ASPARAGUS BEETLE² (*Crioceris duodecimpunctata*)

Order—Coleoptera

This was not found until 1881 and then near Baltimore; it is a rarer and less injurious species than the former one but lives exclusively on asparagus.

The life-history is not so well-known; the eggs are laid on old plants and the larvæ burrow into the berries but

¹Chittenden—U. S. Bu. Ent., Circ. 102.

²Chittenden—U. S. Bu. Ent., Bull. 66, Part 1.

pupate in the ground; the adult beetles damage the new shoots in the spring.

CONTROL—Same as for former species.

THE ASPARAGUS MINER¹ (*Agromyza simplex*)

Order—Diptera

The stalks of asparagus are often injured by the larva of a fly that mines beneath the epidermis; the mines are often so abundant that they have the effect of girdling the stalk.

The white eggs are stuck in the sides of the stalk just beneath the epidermis; they hatch into the small maggots that mine up and down beneath the epidermis; when the larvæ attain their growth they change to puparia; the puparia are attached to the stalk near the ground in slits in the epidermis; probably two generations.

CONTROL—Pull up infested stalks in spring and burn them; allow volunteer plants to grow as a trap crop which should be destroyed in late June.

CUCUMBER PESTS

THE STRIPED CUCUMBER BEETLE² (*Diabrotica vittata*)

Order—Coleoptera

As soon as squashes, cucumbers, etc., appear above the ground in the spring they are attacked by a small yellow and black striped beetle; this beetle is distributed all over the United States east of the Rockies; it is native to this country.

The beetles feed upon the leaves and blossoms and deposit their lemon-yellow eggs in crevices of the soil near stem of plant; the long, slender, whitish larvæ attack the stems by burrowing into them. The larvæ pupate in ground and the beetles hibernate over winter in sheltered places; there are two generations a season.

¹Fink—Cornell Bull. 331.

²Chittenden—U. S. Bu. Ent., Circ. 31.

CONTROL—Put in excess of seeds; protect plants with boxes or wire screen; hand-pick beetles in garden; dust plants with tobacco dust, ashes, lime, etc.; spray with Bordeaux mixture and arsenate of lead or arsenate of lead alone; keep plants covered with this material; practice clean culture.

THE SQUASH BUG¹ (*Anasa tristis*)

Order—Hemiptera

This is a large blackish-brown bug about three-quarters of an inch long that attacks cucurbits of all kinds; when it punctures a leaf to extract the juices it also injects a drop of liquid which has a poisonous effect on the leaf; moreover, it carries bacteria of the wilt disease from one plant to another.

The adult bugs appear in early spring and attack the plants; they lay their dark-brown eggs on the undersides of the leaves in great numbers; these hatch in 8 to 13 days; the nymphs are green and black and abundant; they molt five times and complete their growth in about one month; the adult bugs hibernate under trash, etc.

CONTROL—Trap old bugs in spring with chips or leaves placed under plants; hand-pick adults and eggs; kerosene emulsion diluted with 7 to 9 parts water will kill nymphs but not adults.

SQUASH AND MELON PESTS

THE SQUASH BUG—Already discussed under cucumber pests

THE SQUASH-VINE BORER² (*Melittia satyriniformis*)

Order—Lepidoptera

The parent moth is a beautiful clear-winged moth with a wing expanse of an inch to an inch and a half; it is distributed all over the eastern United States; it attacks

¹Chittenden—U. S. Bu. Ent., Circ., 39.

²Chittenden—U. S. Bu. Ent., Circ. 38.

squash, pumpkin, and occasionally melons, cucumbers, and gourds.

The moths appear in July and deposit their eggs on all parts of the plant, but chiefly along the stems; these hatch and the larva bores into the stem and then burrows along in the center of the stem causing it to rot and become severed from the vine; an affected stem wilts and dies; the larva attains a length of an inch and becomes full-grown in about four weeks; it leaves the stem and goes into the soil to pupate, the pupæ remaining over until the following spring; one brood here.

CONTROL—Insecticides or repellants of little or no avail; cut out the borers; plant the early varieties as a trap crop, or plant late varieties as late as possible; fertilize the soil well, and cover the plants at several joints where new roots can be formed; remove and burn vines as soon as crop has been secured to destroy eggs and larvæ; harrow soil in fall and plow deep in early spring to kill pupæ.

THE MELON PLANT-LOUSE (*Aphis gossypii*)

Passes winter in egg stage; breeds throughout summer like other aphids; is more injurious farther South.

CONTROL—Fumigation with "Nico-Fume-Tobacco" paper and "Aphis Punk" paper; carbon bisulphide.

OTHER INSECTS INJURIOUS TO CUCUMBERS AND MELONS

Twelve-spotted cucumber beetle (*Diabrotica 12-punctata*).

Squash ladybird (*Epilachna borealis*).

Pickle worm (*Diaphania nitidalis*).

Melon caterpillar (*Diaphania hyalinata*).

ONION PESTS

THE ONION MAGGOT¹ (*Pegomya cepetorum*)

Order—Diptera

Closely resembles cabbage maggot; deposits its eggs in crevices of soil near or on onion plant; injures onion

¹Chittenden—U. S. Bu. Ent., Circ. 63.

by mining in it; changes to puparia in soil; later broods more injurious on onion in September and October, when they bore into onions and these decay, causing the plant to droop, wilt and die.

CONTROL—Scallions should be planted late in September or early October; sometimes of advantage to make a small early planting in August as a trap crop; sow late, that is, in latter part of April or early May and force crops; rotate and get away from old infested fields; practice clean culture; use carbolic acid emulsion on onions in garden; use sweetened poison bait.

THE ONION THRIPS¹ (*Thrips tabaci*)

Order—Thysanoptera

This is a very small insect that causes a good deal of annual injury to onions in the United States; is widely distributed all over the country and hard to control.

It passes the winter as adults and probably also as nymphs; the eggs are laid in tissues of the leaves just under the epidermis; they hatch in 3 to 4 days; larval stage 7 to 9 das.; nymph stage 4 das.; whole life cycle 16 das.; many overlapping broods; the adults and the young ones scarify leaves of onions, eating off epidermis; leaves turn white, wilt and die; very injurious at times.

CONTROL—Clean culture in fields and around the borders of fields; spray with the tobacco extracts "black leaf 40," $\frac{3}{4}$ pint to 100 gallons of water and 4 or 5 pounds of soap, preferably whale-oil soap; spray thoroughly and repeat two or three times 4 or 5 days apart; commence just as soon as thrips are seen.

OTHER INSECTS INJURIOUS TO ONIONS

Black onion fly (*Tritoxa flexa*).

Cutworms (several species).

¹Quaintance—Florida Bull. 46.

TOMATO PESTS

CUTWORMS (several species)

Cutworms sometimes cut off the young plants when first set and destroy much more than they eat. A spoonful of the poison bait near each plant when first put out will aid in controlling these pests.

FLEA BEETLES

The potato flea beetle often attacks tomatoes but may be repelled by thorough and frequent applications of Bordeaux mixture. It should be sprayed on the undersides of the leaves as much as possible.

THE TOMATO WORM¹ (*Phlegethontius quinque maculata*)

Order—Lepidoptera

The tomato worm is a large green caterpillar about 3½ inches long; the moths are large; they appear from May to June and deposit eggs singly; the caterpillars complete growth and go into the ground where they pupate; two generations in southeastern New York; last generation passes winter in ground.

CONTROL—Hand pick the larvæ.

THE TOMATO FRUIT-WORM² (*Heliothis obsoleta*)

Order—Lepidoptera

This is the same as the corn ear-worm and boll worm of cotton. It is more abundant farther south. The larva eats into the tomatoes and often destroys large numbers of them.

CONTROL—Plow land in fall or winter. Dust infested plants especially the fruit with powdered arsenate of lead.

¹Chittenden—Insects Injurious to Vegetables, p. 229.

²Quaintance—U. S. Bu. Ent., Bull. 50.

BEET AND SPINACH PESTS

BEET LEAF-MINER¹ (*Pegomya vicina*)

Order—Diptera

A small fly places her eggs on lower sides of leaves; young larvæ mine in leaves; transform to pupæ in soil: life cycle about four weeks; several generations during season.

CONTROL—In gardens pick off and burn infested leaves; plow deep and harrow thoroughly as soon as crop is removed; with beets, use spinach as trap crop.

SPINACH FLEA BEETLE² (*Disonycha xanthomelæna*)

Order—Coleoptera

A shining black flea beetle with red prothorax about $\frac{1}{4}$ inch long greatly injures sugar beets; beetles hibernate over winter; lay eggs at bases of plants; larvæ feed on underside of leaves and later together with adults eat holes in leaves; two generations at Washington, D. C.

CONTROL—Dust plants or spray them with arsenate of lead; use Bordeaux mixture alone or with poison.

OTHER INSECTS INJURIOUS TO BEETS AND SPINACH

Beet aphid (*Pemphigus betæ*).

Sugar-beet webworm (*Loxostege sticticalis*).

Beet army-worm (*Laphygma exigua*).

Flea beetles (several sps.).

Beet leafhopper³ (*Eutettix tenella*).

Blister beetles (several sps.).

BEAN AND PEA PESTS

PEA WEEVIL³ (*Bruchus pisorum*)

Order—Coleoptera

Seed peas often found with a hole in each due to the pea weevil; the weevil is about 1-5 of an inch in length

¹Sirrine—N. Y. Agr. Expt. Sta. (Geneva), 14th Rept.

²Chittenden—U. S. Bu. Ent., Bull. 19.

³Chittenden—U. S. Yearbook, 1898.

and marked with brown and white spots; passes winter as an adult and lays eggs singly in spring on pods in field; on hatching larva bores through pod and into the pea; one generation a year.

CONTROL—Hold peas over one season; plant late; fumigate seed with Cs2.

BEAN WEEVIL¹ (*Bruchus oblectus*)

Order—Coleoptera

Adult beetle is about 1-8 inch in length, with mottled wing covers; eggs laid upon or inserted in the bean-pod through holes made by female; life cycle from 21 to 80 days; probably 5 or 6 generations annually; it also breeds in stored beans.

CONTROL—No method of preventing injury in field; fumigate stored beans and plant clean seed.

THE BEAN LEAF-BEETLE² (*Cerotoma trifurcata*)

Order—Coleoptera

A small reddish black-marked beetle about 1-5 inch long; adults hibernate and lay eggs in cracks of soil near stem of plant; larvæ feed on roots and stems but adults eat holes in leaves; life cycle about 8 or 9 weeks; in South 2 or 3 generations, one in the North.

CONTROL—Spray with arsenate of lead.

THE PEA APHIS³ (*Macrosiphum pisi*)

Order—Hemiptera

Exceedingly injurious to peas some years in New York; life cycle similar to other aphids; passes winter on clover and vetches; flies to peas in spring when these are available; several generations during season; goes back to clover in late season and lays true eggs that pass winter.

¹Chittenden—U. S. Yearbook, 1898.

²Chittenden—U. S. Bu. Ent., Bull. 23.

³Chittenden—U. S. Bu. Ent., Circ. 43.

CONTROL—Do not plant peas near clover; no good remedy on peas sown broadcast; plant peas in rows and brush lice off and bury in soil by cultivation.

OTHER INSECTS INJURIOUS TO PEAS

Cow-pea weevil (*Bruchus chinensis*).

Four-spotted bean-weevil (*Bruchus quadrimaculatus*).

Bean ladybird (*Epilachna varivestis*).

Blister beetles (several sps.).

Bean aphid (*Aphis rumicis*).

Seed-corn maggot (*Phorbia fusciceps*).

Pea-moth (*Semasia nigricana*).

CELERY PESTS

THE CELERY CATERPILLAR¹ (*Papilio polyxenes*)

Order—Lepidoptera

This caterpillar is green or yellowish and ringed with black and spotted with yellow; it becomes 2 inches long; when full-grown it changes to a chrysalis and later the parent insect, a large swallow-tail butterfly, appears.

THE CELERY LOOPER² (*Autographa simplex*)

Order—Lepidoptera

Where it occurs this insect is considered very destructive to celery; the larva is a looper and measures nearly 2 inches in length; the moth is purplish to velvety brown and has a conspicuous silvery comma-like mark on each wing.

CONTROL—Hand picking and poisoning with arsenate of lead.

THE CARROT RUST-FLY³ (*Psila rosæ*)

Order—Diptera

This insect sometimes attacks celery and causes the leaves to turn reddish and the roots to become blotched

¹Davis—Mich. Bull. 102.

²Chittenden—U. S. Bul. Ent., Bull. 33.

³Chittenden—U. S. Bu. Ent., Bull. 33.

with rusty patches. The maggots also tunnel through roots of carrots. The parent insect is a small fly only about 1-6 of an inch in length.

CONTROL—Late sowing and rotation of crops; celery should not follow carrots; clean cultivation and destruction of all remnants and refuse after crop is harvested.

OTHER INSECTS INJURIOUS TO CELERY

Celery leaf-tyer (*Phlyctænia ferrugalis*).

Wire worms (several species).

Tarnished plant-bug (*Lygus pratensis*).

CARROT AND PARSNIP PESTS

Celery caterpillar (*Papilio polyxenes*).

Parsnip leaf-miner (*Acidia fratria*).

Carrot beetle (*Ligyrus gibbosus*).

Parsnip webworm (*Depressaria heracliana*).

Carrot rust-fly (*Psila rosæ*).

INSECTS INJURIOUS TO HOPS

HOP-PLANT BORER¹ (*Gortyna immanis*)

Order—Lepidoptera

This is a native insect that is often seriously injurious to hop vines in New York. The larvæ gnaw the vines below ground eventually killing them. It is distributed from Canada to Washington, D. C., on the south and as far west as Wisconsin, at least. There seems to be some doubt about its occurrence in the hop regions of the Pacific Coast.

The egg is said to be deposited on the tips of the hop vines when they begin to climb; the larva bores immediately into the vine just below the tip; affected vines stop growing, the head turns downward and no longer twines about the pole; such vines are called "muffle heads" or "stag vines"; when the larva is about half an inch long it leaves the tip, drops to the ground and begins to gnaw the stems; the larva becomes 2 inches long, changes to a pupa from the middle to the last of July; the moths appear the latter part of August and in September; some of them winter over probably; also some of the pupæ are said to winter over.

CONTROL—The young larvæ in the tips should be killed by pinching when hops are being tied; the larvæ in the ground should be dug out by hand.

THE HOP-PLANT LOUSE² (*Phorodon humuli*)

Order—Hemiptera

This insect is widely distributed here and in Europe wherever the hop grows. It is often exceedingly destructive.

The eggs are laid in the fall on different varieties of plums and also it is said on the hop vines themselves. Here they remain and hatch in the spring. The winged forms of the third generation go from the plums to the

^{1 2}Howard—U. S. Bu. Ent. Bull. 7.

hops where they live until fall. They multiply rapidly and sometimes cover the leaves and stunt the vines. At picking time a winged generation flies back to the plums and gives birth to the true females which lay the eggs. In case no plums are present it seems that the eggs may be laid on the hop vines at or below the ground.

CONTROL—Spray with “black leaf 40,” $\frac{3}{4}$ pint to 100 gallons of water with 8 pounds of whale-oil soap.

HOP-VINE SNOOT-MOTH¹ (*Hypona humuli*)

Order—Lepidoptera

The larvæ of this moth are sometimes exceedingly destructive to the vines which they soon defoliate when abundant. It seems to have no other food plant than the hop and follows this plant in its distribution.

The larvæ are semi-loopers for they lack the first pair of prolegs; the pale green eggs are laid on the undersides of the leaves; the larvæ eat the leaves voraciously; the larvæ are said to pupate in the ground, in crevices in the poles and in leaves; there are two generations a year, the last brood of moths hibernating in protected places; there is much conflicting testimony about it and little is certainly known.

CONTROL—Spray vines with arsenate of lead, $2\frac{1}{2}$ pounds to 50 gallons, or dust vines with powdered arsenate of lead, 4 pounds to the acre. It can be mixed with sulphur which is used for the mildew.

HOP MERCHANTS² (*Polygonia interrogationis*) (*Polygonia comma*)

Order—Lepidoptera

The so-called hop merchants are simply the shining chrysalids of these two butterflies. The caterpillars of each are covered with branching spines and live upon the foliage of the plants. Both butterflies have two generations but the first generation of each is spent upon

^{1 2}Howard—U. S. Bu. Ent., Bull. 7.

food plants other than the hop. The second generation of each is spent on the hop, the butterflies hibernating through the winter. Both butterflies show a dimorphism, the fall or winter forms differing from the summer forms.

CONTROL—Use the powdered arsenate of lead, as for the snout-moth.

OTHER INSECTS INJURIOUS TO HOPS

Red Spider (*Tetranychus telarius*).

Hop flea beetle (*Psylliodes punctulata*).

Hop red bug (*Paracalocoris scrupeus*).

Tufted looper (*Ania limboda*).

Leaf hoppers (*Typhlocyba* sps.).

INSECTS INJURIOUS TO FORAGE CROPS

WHEAT PESTS

THE HESSIAN FLY¹ (*Mayetiola destructor*)

Order—Diptera

Probably the most injurious pest on wheat in the United States; imported from Europe and first noticed on Long Island in 1779; attributed to the Hessian soldiers in the Revolutionary War. Passes winter as pupa or full-grown larva between blades and stalk of winter wheat; adults appear in spring (May) and lay eggs on upper surface of leaves; maggots hatch and go to the bases of leaves above first and second joints; maggot stage 20 das. or more; changes to a puparium and passes the summer as such in stubble; fall flies appear in August and first days of September; these lay eggs and produce puparia which pass the winter again; some flies may issue before winter.

FOOD PLANTS—Eggs often on grass but larvæ live only on wheat, barley and rye; so-called red wheat seems to be more exempt from injury than the white wheat (see Felt U. S. Bull. 31, p. 22); drought prolongs the flaxseed stage greatly.

CONTROL—Burn stubble or plow under to destroy flaxseeds; most efficient measure; destroy volunteer wheat; sow wheat late, not earlier than September 20th to escape deposition of eggs by fall flies; sow strips of wheat early in August and then plow under or burn first week in September.

THE WHEAT MIDGE² (*Contarinia tritici*)

Order—Diptera

An old European pest closely allied to the Hessian fly; the adult is bright orange colored and about one-third the size of a mosquito; the flies lay eggs in June between

¹Webster—U. S. Bu. Ent., Circ. 70. .

²Marlatt—U. S. Farmers' Bull. 132.

the chaff of wheat heads; eggs hatch in about a week, and the reddish-yellow maggots extract the juices from the kernels causing the latter to become much shrunk and worthless either for seed or for flour; these "red-weevils" or maggots become full-grown in 3 or 4 weeks and some leave the heads, usually during a rain storm; these go into the ground and remain in cocoons until spring; others are carried into the thresher and come out in the screenings; they remain in the chaff in a dried-up condition until spring; now occurs in nearly all the states east of the Mississippi; shrivelled kernels will not grow good strong plants, nor make good flour, hence such had better be fed out; no varieties are exempt, but beardless varieties suffer more injury than the bearded.

CONTROL—Burn or feed out screenings; after harvesting deeply plow under the stubble; rotate the wheat to some distant field; early sown wheat may escape with less injury by the midge, but is more liable to the attack of the Hessian fly.

THE CHINCH-BUG¹ (*Blissus leucopterus*)

Order—Hemiptera

Not often injurious in the East; has been injurious over small areas in New York several times; two broods of the insect a year; winters in the stools of grasses in the adult stage.

CONTROL—Western methods of fighting the insect with barriers and fungus diseases; consult bulletins and circulars from the Kansas and Illinois Experiment Stations.

WIREWORMS² (several species)

Order—Coleoptera

These pests are the larvæ or grubs of click-beetles of the family Elateridæ. There are at least eight species that are injurious; the grubs are yellowish, cylindrical,

¹Marlatt—U. S. Farmers' Bull. 132.

²Comstock and Slingerland—Cornell Bull. 33.

and hard like wire, hence the name wireworms; these wireworms live two and in most cases nearly three years in the soil and near the end of the third summer they change to pupæ in cells in the soil and later the pupæ transform to the adult beetles which remain in their cells until spring thus taking three years to complete their life history; the beetles lay their eggs at the roots of grasses.

CONTROL—Difficult to control; conflicting evidence regarding coating of seeds; plowing and thorough cultivation in August and later for 2 or 3 years will kill the pupæ and finally check the pests; salt will not kill wireworms unless it is applied in such large quantities that it completely unfits the soil for growing crops and even then is a doubtful killing agent.

THE WHEAT STEM-MAGGOT¹ (*Meromyza americana*)

Order—Diptera

The winter is passed as a larva; the adult flies emerge in May and deposit their eggs on wheat plants; second brood of adults appears in July and deposits eggs on volunteer wheat and grasses; adults from these eggs emerge in late August to October, and deposit eggs on young fall wheat plants, where they hatch into larvæ and pass the winter; the larvæ do the injury to young plants in fall and spring.

CONTROL—Sow late as for Hessian fly.

THE WHEAT STRAW-WORM² (*Isosoma grande*)

Order—Hymenoptera

This pest is mainly injurious west of the Mississippi, but is distributed east.

The adults always small and frequently wingless, emerge in April from stubble and deposit eggs in stems of young plants; the larva eats out the embryonic head of the wheat plants and when full-grown goes down to the crown; adults appear from these, large and robust

¹Marlatt—U. S. Farmers' Bull. 132.

²Webster and Reeves—U. S. Bu. Ent., Circ. 106.

in June, and deposit eggs in stems just above the upper joints usually; by October the larvæ pupate and pass the winter in stubble.

CONTROL—Burn stubble; rotate crops.

THE WHEAT JOINT-WORM¹ (*Isosoma tritici*)

Order—Hymenoptera

First serious outbreak in Virginia in 1848–1854 and reappeared in Indiana, Michigan, Ohio, Pennsylvania, Virginia, Maryland, and Kansas, in 1904–1908.

Lives over winter as a larva in wheat straws; adults appear in April or May and lay eggs in stems of plants; larvæ form cells in stems and feed there until straw hardens and grain ripens; change to pupæ in spring; the larvæ deform the straws, galls being formed above the joints; grains remain small and shrivelled or none produced.

CONTROL—Strengthen fertility of soil to produce strong plants; burn stubble where not seeded or plow under deeply; rotate crops.

THE ARMY WORM² (*Heliothrips unipuncta*)

Order—Lepidoptera

For years there have been outbreaks of this pest in various localities in the eastern United States. Outbreaks in New York State in 1861, 1875, 1880, 1896; the larvæ migrate in immense numbers from one field to another, destroying the vegetation in their path.

The eggs are deposited in unfolded grass leaves or into the sheath of the leaf where it clasps the stem; the larvæ attain their growth in about 30 days and go into the ground to pupate; the pupal stage lasts from 10 days to 3 or 4 weeks depending on the season; the winter is passed as larvæ; there are evidently three broods, the middle of July brood being the most abundant and injurious.

¹Webster—U. S. Bu. Ent., Circ. 66.

Houser—Ohio Bull. 226.

²Forbes—23d Rept. Ill. State Ent.

CONTROL—Usually fought by barriers in the same way as the chinch bug and by poison baits (see page 94).

OTHER INSECTS INJURIOUS TO WHEAT

Spring grain-aphis (*Toxoptera graminum*).

Wheat sawfly borer (*Cephus pygmæus*).

Wheat sawfly (*Pachynematus extensicornis*).

Wheat-louse (*Nectarophora avenæ*).

Leather-jackets (*Tipulidæ* sps.).

CORN PESTS

WIREWORMS (several species)

These have been fully discussed under wheat pests. They are quite as injurious to corn as to wheat. In fact, they constitute one of the chief pests of corn in New York State.

THE ARMY WORM (*Heliophila unipuncta*)

The army worm is injurious to wheat, corn, oats, and many other grains. There are occasional outbreaks of this insect in New York, which are often very serious. The season of 1914 witnessed some serious injuries by this insect. It has been discussed under wheat pests.

CUTWORMS (several species)

There are several species that injure corn as well as wheat. They are apt to be more abundant and severe on corn planted on sod. They have been discussed under wheat pests.

WHITE GRUBS (*Lachnosterna* sps.)

These are injurious to many crops notably, strawberries, wheat, corn and oats. They were discussed under strawberry pests.

SOD WEBWORMS¹ (*Crambus* sps.)

Order—Lepidoptera

These are the larvæ of a family of small moths of the family *Crambidæ*; the larvæ are about one-half inch

¹Forbes—23d Rept. Ill. State Ent.

in length and pinkish-red or brownish; they work at first underground gnawing away the outer surface of the stem and roots; later, they burrow up the center of the stem; they also sometimes eat the leaves; usually the web-worms will be found just below the surface each in a retreat formed by loosely webbing together a mass of dirt; within the mass is a silk-lined tube and within this a caterpillar; so far as known all of the species pass the winter as caterpillars not full-grown.

CONTROL—Break land early in fall or as late as possible in spring to destroy larvæ.

THE CORN BILL-BUGS¹ (*Sphenophorus* sp.)

Order—Coleoptera

These are snout-beetles of various sizes and colors; they are more common in the South than here; with exception of one species, the grub of which may live in the pith of the stalk, the injury to corn is done by adult beetles.

THE CHINCH BUG (*Blissus leucopterus*)

The pest often attacks corn as well as wheat and becomes very injurious where it is abundant. It has been discussed under wheat pests.

OTHER INSECTS INJURIOUS TO CORN

Stalk-borer (*Papaipema nitela*).

Seed-corn maggot (*Phorbia fusiceps*).

Corn ear-worm (*Heliothis obsoleta*).

Corn root-aphis (*Aphis maidiradicis*).

Northern corn root-worm (*Diabrotica longicornis*).

¹Forbes—23d Rept. Ill. State Ent.

CLOVER AND ALFALFA PESTS

CLOVER ROOT-BORER¹ (*Hylastinus obscurus*)

Order—Coleoptera

A small, dark-brown beetle imported from Europe that works on second year and older clover roots; eggs laid in cavities dug in roots and larvæ bore galleries in the roots causing plants to wilt and break off at crown; pupæ form in cavities in roots and adults appear by October but remain in roots over winter feeding when not dormant; attacks alfalfa, red clover, mammoth clover and alsike.

CONTROL—Plow an infested field immediately after hay gathered; never allow clover to stand more than two years if it becomes infested.

CLOVER LEAF-BEETLE² (*Hypera punctata*)

Order—Coleoptera

A small beetle which works on the leaves, mostly at night; the grubs also work in a similar manner; most of its injury is done in May and June; when full-grown the grubs change to pupæ in peculiar, yellowish network cocoons of silk in the soil; beetles usually hibernate but many die before spring; larvæ hibernate through winter.

CONTROL—A fungus disease usually kills the grubs in most localities; plow under the infested fields after second season thus destroying the early stages of the insect.

CLOVER FLOWER-MIDGE³ (*Dasyneura leguminicola*)

Order—Diptera

This fly often prevents the formation of seed; eggs are laid in green flower-heads and the maggots suck out the contents of ovary; when grown the maggots enter the

¹Folsom—Illinois Bull. 134.

Howard—U. S. Bu. Ent., Circ. 4.

² ³Folsom—Illinois Bull. 134.

ground and pupate; the insect passes the winter either as pupa or a larva in the soil or in dead clover heads; there are two broods and a partial third; most damage to seed crop is done latter part of August or first part of September; most injury occurs to second-year clover and keeps increasing as clover is allowed to stand.

CONTROL—Cut first crop of clover as early as possible to allow seed to form early ahead of second generation of midges; pasturing the first crop does almost as well.

CLOVER SEED-CATERPILLAR¹ (*Enarmonia interstinctana*)
Order—Lepidoptera

The caterpillars of this moth eat out cavities in the heads of clover and often become very destructive; there are three broods a season; probably pass the winter as larvæ occasionally, usually as pupæ.

CONTROL—Cut and store hay crops early in June; do not allow clover to run more than two years; pasture clover in fall of first year.

CLOVER SEED-CHALCID² (*Bruchophagus funebris*)
Order—Hymenoptera

This small wasp-like insect is one of our worst clover pests; the tiny larvæ eat out the insides of the seeds leaving only a thin shell; the insects pass the winter mostly as larvæ in the seeds on the ground; the adults appear about May 15th and lay their eggs in flowers of clover; second brood appears in July and August; injury is greatest to the second-year clover.

CONTROL—Cut first crop early, as soon as the field comes into bloom; plow up clover after second crop, plow early in spring.

CLOVER HAY-WORM³ (*Hypsoptygia costalis*)
Order—Lepidoptera

This hay-worm works in stacked or stored clover, eating much of it and contaminating much more with

^{1 2 3}Folsom—Illinois Bull. 134.

webs of silk and particles of excrement, making the hay unfit for fodder.

CONTROL—In a barn, old hay should be removed and burned if infested; a stack should be raised above the ground on old logs or rails; salt bottom of stack up two or three feet.

THE ALFALFA LEAF-WEEVIL¹ (*Phytonomus murinus*)

Order—Coleoptera

Introduced from Europe; first found in 1904 near Salt Lake City, Utah; very destructive and hard to control; the adult is a snout beetle about 3-16 inches in length; hibernates as an adult; lays eggs in spring down between leaves or in punctures in the stems of clover plants; the life cycle may be from 40 to 70 days and adult beetles may live from 10 to 14 months; apparently confined to Utah but liable to spread widely.

CONTROL—Very difficult to control; cut first growth when most of eggs laid and brush-drag the field; clean culture about fields to destroy the hibernating places; do not grow alfalfa more than 7 or 8 years in infected districts.

OTHER INSECTS INJURIOUS TO CLOVER AND ALFALFA

Clover leaf-midge (*Dasyneura trifolii*).

Clover stem-borer (*Languria mozardi*).

Clover sitones (*Sitones flavescens*).

Clover-root mealy bug (*Pseudococcus trifolii*).

Alfalfa looper (*Autographa gamma californica*).

Clover-root curculio (*Sitones hispidulus*).

Alfalfa gall midge (*Asphondylia miki*).

Lesser clover-leaf weevil (*Phytonomus nigrirostris*).

¹Titus—Utah Bull. 110.

COTTON PESTS

MEXICAN COTTON BOLL-WEEVIL¹ (*Anthonomus grandis*)

Order—Coleoptera

Introduced from Mexico about 1892; a grayish-black snout beetle, about $\frac{1}{4}$ inch in length; punctures squares and bolls and deposits eggs in them: life cycle about 15 to 20 days; several generations in a season and all stages passed in squares and bolls; passes winter as adults and causes millions of dollars loss each year.

CONTROL—Plant cotton early; plant early varieties and hasten maturity by fertilization and cultivation; plant wide in rows; burn infested plants in fall to destroy all stages of weevil; rotate crops and diversify.

COTTON WORM² (*Alabama argillacea*)

Order—Lepidoptera

The cotton moth lays its eggs on leaves of cotton; young larva feeds for a time on the undersides of leaves but soon begins to devour leaves entirely; changes to a pupa in a flimsy cocoon in a leaf; life cycle about four weeks on the average; several generations during a season; passes winter as adults in extreme South; migrate northward in spring.

CONTROL—Dusting cotton with powdered arsenate of lead best method; this insect is now held to be of value in controlling the boll weevil and therefore is not fought as it used to be.

COTTON BOLL-WORM³ (*Heliothis obsoleta*)

Order—Lepidoptera

One of the serious pests of cotton; moth deposits ribbed eggs on leaves of cotton; larva feeds for a short time on leaves but soon bores into a boll where it destroys the lint; life cycle about 30 days in summer; four genera-

¹Hunter—Far's. Bull. 344, U. S. Dept. Agri.

²Hunter—U. S. Bu. Ent., Circ. 153.

³Quaintance—U. S. Bu. Ent., Bull. 50.

tions a season; passes winter as pupa 3 to 6 inches below the surface of the soil; also attacks corn and tomatoes.

CONTROL—Use trap crops of corn; plough land thoroughly during fall and winter; plant crop early in spring; rotate and diversify crops.

OTHER INSECTS INJURIOUS TO COTTON

Cotton aphid (*Aphis gossypii*).

Cotton root-louse (*Aphis maidiradicis*).

Cotton red spider (*Tetranychus telarius*).

Cotton stalk-borer (*Ataxia crypta*).

Cotton stainer (*Dysdercus suturellus*).

TOBACCO PESTS

TOBACCO FLEA BEETLE¹ (*Epitrix parvula*)

Order—Coleoptera

A small yellowish-brown flea beetle about 1-20 of an inch long; it eats small holes through tobacco leaves; eggs probably laid near food plants and larvæ feed on roots; life cycle apparently about one month; probably three generations; adults winter over.

CONTROL—Destroy all weeds of the potato family; in seed beds and in fields arsenate of lead seems to give best results.

SOUTHERN TOBACCO HORN-WORM² (*Phlegethontius sexta*)

Order—Lepidoptera

Large green worms with horn on posterior end of body; they eat ravenously and do much injury; when full-grown goes into soil to pupate; pupa large and proboscis forms a handle-like organ; life cycle in summer about six weeks in South; two broods; last brood passes winter in ground as pupa; the adult moth has wing expanse of about 5 inches.

¹Morgan—U. S. Bu. Ent., Circ. 123.

²Morgan—U. S. Bu. Ent., Circ. 123.

CONTROL—Hand pick; dust tobacco with powdered arsenate of lead.

TOBACCO SPLITWORM¹ (*Phthorimæa operculella*)

Order—Lepidoptera

Eggs laid on leaves of plant; larvæ mine between the surfaces of the leaves; two or more generations in a season; also works in tubers of potatoes.

CONTROL—Clean cultivation; rotation of crops; probably arsenical sprays.

OTHER INSECTS INJURIOUS TO TOBACCO

Cut worms (several species).

False tobacco bud worm (*Heliothis obsoleta*).

Tobacco bud worm (*Chloridea virescens*).

Tobacco "suck-fly" (*Dicyphus minimus*).

Cigarette beetle (*Lasioderma serricorne*).

¹Chittenden—U. S. Bu. Ent., Circ. 162.

INSECTS INJURIOUS TO STORED GRAIN

The more important pests are:

The granary weevil (*Calandra granaria*).

The rice weevil (*Calandra oryzae*).

The saw-toothed grain beetle (*Silvanus surinamensis*).

The Angoumois grain moth (*Sitotroga cerealella*).

The Indian meal moth (*Plodia interpunctella*).

The Mediterranean flour moth (*Ephestia kuehniella*).

The bean weevil (*Bruchus obtectus*).

The pea weevil (*Bruchus pisorum*).

CONTROL—One of the best ways to keep seed corn, seed peas, wheat, beans, etc., is to store them in barrels or tight boxes; fill the boxes or barrels within 4 or 5 inches of the top and cover; if weevils or moths get in them pour carbon bisulphide, at the rate of 2 pounds to 100 bushels of grain, into a tin dish and set this on top of the grain and cover the box or barrel with old blankets; leave covered 3 or 4 days; the liquid will evaporate and the gas will settle down through the grain and kill the insects; do not go near the boxes with a light of any kind until the covers have been removed and the boxes thoroughly aired.

See U. S. Dept. Agrl. Farmers' Bull. 45.

INSECTS INJURIOUS TO GREENHOUSE PLANTS

WHITE-FLY (*Aleyrodes vaporariorum*)

Order—Hemiptera

The nymphs are small, greenish, scale-like insects found on the undersides of the leaves; the adults are minute, white-winged flies.

CONTROL—Spray with kerosene emulsion or whale-oil soap or “black leaf 40” and soap; if infesting cucumbers or tomatoes fumigate over night with hydrocyanic acid gas, 1 ounce of potassium cyanide to 1,000 cubic feet of space.

GREEN APHIS (*Myzus persicae*)

Order—Hemiptera

CONTROL—Spray with kerosene emulsion or “black leaf 40” and soap or fumigate with tobacco paper; if on violets fumigate with $\frac{1}{2}$ to $\frac{3}{4}$ ounce potassium cyanide to 1,000 cubic feet of space and leave gas in $\frac{1}{2}$ to 1 hour.

BLACK APHIS (*Nectarophora chrysanthemicolens*.)

Order—Hemiptera

CONTROL—This is harder to kill than the green aphid but may be controlled by the same methods although a little more persistence may be demanded.

RED SPIDER (*Tetranychus telarius*)

Order—Acarina

These mites attack house plants and plants in greenhouses and plants in flower gardens.

CONTROL—Syringe off the plants with clear water 2 or 3 times a week, taking care not to drench the beds in greenhouse; on outdoor plants use sulphur mixed in water at the rate of 16 pounds to 50 gallons water.

VIOLET GALL FLY (*Diplosis violicola*)

Order—Diptera

Violets grown under glass are often greatly injured by a very small maggot which causes the edges of the leaves to curl, turn yellowish and die; the adult is a very minute fly resembling a mosquito.

CONTROL—Pick off and destroy infested leaves as soon as discovered; fumigation is not advised.

GREENHOUSE LEAF TYER (*Phlyctænia ferrugalis*)

Order—Lepidoptera

An old offender in greenhouses; attacks chrysanthemums, geraniums, cinerarias and other plants; eats off lower epidermis of leaves, ties them together and causes much injury; the caterpillar is about $\frac{3}{4}$ inches in length, greenish-white in color with stripes along the back; several generations in a year.

CONTROL—Hand picking is about the only remedy.

OTHER INSECTS INJURIOUS IN GREENHOUSES

Marguerite fly (*Phytomyza chrysanthemi*).

White grubs (*Lachnosterna* sps.).

Leaf roller (*Archips rosaceana*).

Cut worms (*several species*.)

INSECTS INJURIOUS TO SHADE TREES

THE ELM LEAF-BEETLE¹ (*Galerucella luteola*)

Order—Coleoptera

Introduced from Europe and first found here in 1834 in Baltimore; the beetle is about one-fourth of an inch long, brownish-yellow in color with a dark line along each side of its back; the adults and larvæ eat the leaves and defoliate the trees.

The full-grown beetles hibernate in cracks and crevices especially in attics of houses and appear in spring as the leaves are putting out; they lay their orange-colored eggs on the undersides of the leaves; these hatch in 5 or 6 days; the grubs eat the leaves and mature in 15 to 20 days and pupate at the bases of the trees on top of the ground; in 6 to 10 days the adults appear and in New York there is a second generation.

CONTROL—Spray with arsenate of lead as trees come in full leaf for the beetles and again about 3 weeks later for the grubs; use 3 to 4 pounds to 50 gallons of water; the Gipsy-moth Commission sprays but once and uses 5 pounds to 50 gallons; they spray as soon as trees come into good leafage.

THE ELM LEAF-MINER² (*Kaliosysphinga ulmi*)

Order—Hymenoptera

The leaf-miner is another European insect but it works on Scotch and English elms; it is a sawfly and the larvæ "blister" and kill the leaves; the adults are small, shining black sawflies, about one-eighth of an inch long.

The eggs are laid in May beneath the epidermis of the leaves and the larvæ mine in the tissues of the leaf making large irregular mines or "blisters" in the leaves; they become mature in July and go into the ground

¹Herrick—Cornell Bull. 333.

Felt—Bull. 20 of the N. Y. State Museum.

²Slingerland—Cornell Bull. 233.

Herrick—Cornell Bull. 333.

where they make thin papery cocoons and remain in them until next spring; they then change to pupæ and the flies appear in May; only one generation.

CONTROL—Spray the leaves just as the mines begin to show, about first of June, with "black leaf 40," 1 pint to 100 gallons of water with 5 pounds of soap.

THE WHITE-MARKED TUSSOCK-MOTH¹ (*Heemerocampa leucostigma*)

Order—Lepidoptera. Manual p. 310

The tussock moth is a native insect that is very injurious at times to shade-trees and fruit-trees; the larva is very striking in appearance; it is two inches long and bears four tufts or tussocks of creamy white hairs on its back with two long pencils of hairs on its head and a third on the posterior end of the abdomen.

The moth lays its eggs in whitish masses in summer on the trees; they remain here until the following spring and then hatch into the caterpillars that strip the trees of foliage; these caterpillars often migrate from tree to tree; when full-grown they make cocoons on the trees and change to pupæ; one brood a season except in extreme southeastern part of State.

CONTROL—Collect egg masses during fall and winter; spray trees with arsenate of lead, 3 pounds to 50 gallons; band trees with cotton in June, July, and August.

THE FALL WEB-WORM² (*Hyphantria cunea*)

Order—Lepidoptera. Manual p. 321

This is a typical American species and found from Canada to Texas; it has been recorded as feeding upon 120 species of trees; the moths are white or spotted with black and conspicuous; the larvæ make ugly silken nests all over affected trees.

The moths lay 400 to 500 eggs in clusters on the leaves; the caterpillars feed in masses and spin webs enclosing

¹Howard—U. S. Farmers' Bull. 99.

²Felt—Insects Affecting Park and Woodland Trees, Vol. I, p. 142.

leaves; they pupate in cocoons on ground under trash or about trunks of trees; farther south there are two broods, but only one in central and northern New York; the pupæ pass the winter in cocoons.

CONTROL—Cut out nests of larvæ; spray with arsenate of lead around the nests of the larvæ.

BRONZE BIRCH-BORER¹ (*Agrilus anxius*)

Order—Coleoptera

This is a small olive-bronze colored beetle about one-half an inch long that is killing so many of the white birches in New York State. It attacks the tops branches first but gradually spreads to all parts of the tree. The larvæ bore through the sap-wood just beneath the bark and sometimes deeper into the solid wood. The larvæ pupate in cells beneath the bark and in May or early June the beetles make round exit holes in the bark and emerge through these.

CONTROL—The only way of arresting the spread of the pest and stopping the death of healthy trees is to cut down and burn the infested ones before May first.

WILLOW AND POPLAR BORER² (*Cryptorhynchus lapathi*)

Order—Coleoptera

This is a beetle somewhat resembling the plum curculio, but much larger, that is becoming a serious menace to poplar and willow trees both in the nursery and on the lawn. The larvæ bore through the wood finally causing the death of the tree. The presence of the larvæ is indicated by the appearance of sawdust and particles of excrement thrown outside.

CONTROL—Cut out infested portions and burn before June.

¹Slingerland—Cornell Bull. 234.

²Schoene—Geneva Bull. 286.

HICKORY BARK-BORER¹ (*Scolytus quadrispinosus*)

Order—Coleoptera

The adult is a small brown or black beetle about one-fifth of an inch long; the leaves wilt and twigs die in midsummer and the bark will be found full of small shot-like holes through which the beetles have emerged; it is a most serious pest to hickory trees.

The beetles appear last of June to last of July; they bore in young twigs, terminal buds and green nuts; females make galleries just under bark in sapwood and lay eggs in niches along the sides; larvæ tunnel through sapwood and kill trees; grubs pass winter nearly full grown in galleries under bark.

CONTROL—Cut out badly infested trees and affected portions of others and burn before June.

THE SNOW-WHITE LINDEN MOTH² (*Ennomos subsignarius*)

Order—Lepidoptera

Half a century ago this insect was a pest of shade-trees in Brooklyn and Philadelphia; became abundant again in 1907 and then was injurious in forests of New York for four years; the moths are pure white and have the habit of appearing in enormous numbers around lights in cities where their appearance has been compared to snowstorms.

Eggs are laid on branches in masses of 20 to 100 or more in June and July; hatch the next spring in April and May; caterpillars strip leaves and mature in June and July and pupate in loose cocoons on leaves; moths appear from middle of June to last of July and soon deposit eggs; one brood a year.

CONTROL—On fruit trees spray with arsenate of lead, 2½ pounds to 50 gallons of water; no control for forest trees known.

¹Felt—Insects Affecting Park and Woodland Trees, Vol. 1, p. 275.

²Herrick—Cornell Bull. 286.

THE BROWN-TAIL MOTH¹ (*Euproctis chrysorrhæa*)

Order—Lepidoptera

Probably introduced from Holland on shipments of roses by nursery in Somerville, Mass., about 1893; now in Massachusetts, Rhode Island, Connecticut, and New Hampshire and other states; the larvæ feed on pear, apple, cherry, peach, and other fruit-trees and on forest-trees; the moths are pure white with a tuft of brown hairs on end of abdomen, hence name, "brown-tail" moths; the hairs of the larvæ are brittle and barbed and when they strike the skin cause a nettle or rash quite serious to some people.

Eggs laid in July in masses of 200 to 400 on leaves and covered with brown hair from body of female; they hatch and the larvæ feed in groups on leaves until fall when they go into hibernation in hibernacula made by webbing many leaves together, at the ends of branches; in the spring they eat leaves again and become full-grown latter part of June; pupate in cocoons in crevices of bark and other nooks; moths appear in July; one generation a season.

CONTROL—Spray with arsenate of lead for caterpillars 3 to 5 pounds to 50 gallons of water; cut out nests of larvæ during dormant period of tree.

THE GIPSY MOTH² (*Porthetria dispar*)

Order—Lepidoptera

The gipsy moth gained a foothold by the escape of larvæ or eggs from the cages of Professor Trouvelot at Malden, Mass., about 1869; now found in Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine; the female moth has white wings marked with dark, wavy lines while the male is light brown in color.

Eggs laid in clusters of 300 to 400 in July and covered with hair; they are deposited in crevices of bark, brush piles, stone-walls, etc., and hatch the next spring in May; larvæ mature last of June and first of July and pupate in

¹ ²Rogers and Burgess—U. S. Bu. Ent. Bull. 87.

various places in thin network of silk; the moths appear in July and deposit eggs; only one generation a year; the food plants are almost all trees, especially apple, oak, and willows.

CONTROL—Spray trees with arsenate of lead, 3 to 5 pounds to 50 gallons of water; burlap trees for hiding places for larvæ and then kill the caterpillars; tanglefoot of use in catching larvæ; treat egg-clusters with crude coal-tar creosote blackened with lampblack to tell what ones have been treated.

OTHER INSECTS INJURIOUS TO SHADE TREES

Pigeon horn-tail (*Tremex columba*).

Maple borer (*Plagionotus speciosus*).

Elm borer (*Saperda tridentata*).

Maple scale (*Pulvinaria innumerabilis*).

Leopard moth (*Zeuzera pyrina*).

Locust borer (*Cyrtene robiniae*).

INSECTS INJURIOUS TO FARM ANIMALS

SHEEP PESTS

SHEEP BOTFLY OR HEAD MAGGOT¹ (*Æstrus ovis*)

Order—Diptera. Manual, p. 478

The adult insect is a two-winged fly that deposits living maggots in the nostrils of sheep; the maggots pass upward into the nasal sinuses and sometimes into the horns; accounts record the presence of the maggots in the brain; the maggots attach themselves to the delicate membranes by means of two hooks and feed upon the mucous secretions, causing catarrh and staggers; when full-grown the maggots are sneezed out through the nostrils and go into the ground to undergo their transformations; the flies are most active in June and July; the maggots live in the nose about ten months; the adults have no functional mouth-parts and do not feed.

CONTROL—Plow a piece of land in pasture and harrow until fine and dusty for sheep to stand on; smear noses often in summer with equal parts of tar and grease; bore holes in a log and put salt in them after which smear edges of holes with tar and grease; no medicine will reach grubs; do not use a wire in nostrils.

ITCH OR SCAB² (*Psoroptes communis*)

Order—Acarina

Sheep scab is strictly a contagious disease and is responsible for much loss among western sheep growers, through death of animals and damage to wool; also exporters suffer loss because American live stock are prohibited from Europe.

Scab is caused by small mites that work in the skin causing the wool to fall off and producing large scabs over the body; there are four varieties of mites that work

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 102.

²Salmon and Stiles—U. S. Bu. An. Ind., Bull. 21.

on sheep and cause scab—the mite causing the common or “body scab”; the mite causing the “head scab”; the mite causing the “foot scab”; and the mite causing the “follicular scab” affecting the eyelids.

The common scab is a severe itching disease and occurs most often on the backs and sides where the wool is longest; it is the worst form of the disease in this country; the mites multiply with wonderful rapidity; one female lays 15 to 24 eggs which hatch in 2 or 3 days, and in 15 days the young become adults; in 3 months a single female can produce 1,000,000 progeny.

CONTROL—When far advanced, soften the scab with some kind of grease or oil, and then apply some of the common “sheep dips”; the active ingredients in most “dips” are tobacco, arsenic and carbolic acid; each sheep will require from a quart to a gallon; use the dip at a temperature of 100 degrees in summer and 10 degrees warmer in winter; a simple method of treating a few sheep is to turn them on their back and pour the dip along the middle line of the venter; where large numbers are to be dipped, special tanks are made; a kerosene emulsion is also a good sheep “dip”; a second or third dipping may be necessary, as the dips do not often kill the eggs, and another brood may appear later.

THE SHEEP “TICK” (*Melophagus ovinus*)

Order—Diptera. Manual, p. 488

A curious, degraded, wingless insect belonging to the same order as the gad-flies and the common housefly; it is thus not a true tick; very common on sheep, but seldom causes serious injury to old sheep; lambs are often worried and hindered from acquiring fat; the “ticks” cling very tenaciously to the skin and suck the blood; the eggs are hatched within the body of the flies, the maggot is nourished there until it is nearly full-grown, and is not born until it is ready to change to a pupa; each fly produces from two to fifteen of these brown puparia, one-third as large as the mother fly; they are

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 138.

laid in the wool to which they adhere, and they give out the adult fly in about three weeks; the "ticks" are most numerous in the spring, cause much irritation, and hinder young lambs from making their normal growth; their whole life is spent on the sheep.

CONTROL—Keep the pen clean; after shearing, apply any of the standard "dips" or kerosene emulsions.

THE SHEEP LOUSE (*Trichodectes sphærocephalus*)

A biting louse that works at the base of the wool; not often abundant.

CATTLE PESTS

THE OX WARBLE, OR HEEL FLY¹ (*Hypoderma lineata*)

Order—Diptera. Manual p. 478

The ox bot-fly is widely distributed in this country and Europe; it is found on the buffalo (Bison) here; it causes much loss by affecting the general health of animals and also by its perforations of hides, thus lowering their value.

The adult flies are about one-half inch in length and bee-like in appearance; the eggs are apparently laid on the hair around the heel and on the lower part of the leg, although it was formerly thought, and this idea is not now wholly abandoned, that the egg was laid along the back; Curtice showed that the cattle licked the eggs and conveyed the larva to the mouth where it passed through the oesophagus and worked its way just beneath the skin to its final resting place along the back; there the larvæ produce swellings or warbles and after completing their growth wriggle out and go into the ground in the spring; here they change to pupæ and finally the adult fly appears; the flies seem to annoy cattle very much although they do not bite or sting; 50% of the cattle in the Mississippi Valley are affected.

CONTROL—Apply kerosene or grease to the "warbles" in the winter, or as soon as noticed; this will close up the

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 97.

breathing holes of the maggots and cause their death; remove by squeezing or otherwise, the maggots from the "warbles".

THE HORN-FLY¹ (*Hæmatobia serrata*=*Lyperosia irritans*)

Order—Diptera

The horn-fly is another importation from Europe; it came to America in 1886 and landed near Philadelphia apparently; it is now distributed all over the country; the adults are about half as large as the house-fly; they annoy cattle very much and cause a large loss to the milk supply.

The flies lay their eggs in fresh cow droppings; the maggots attain their growth there in a few days and burrow just beneath the surface of the earth and change to pupæ; the adults soon appear; the whole life cycle may be gone through in two weeks and there are four or five broods in a season. The adults have a habit of gathering on the bases of the horns but cause no injury at this place; the flies are common from May until frosts of autumn.

CONTROL—Almost any greasy substance, like axle grease, fish oil, kerosene emulsion, crude petroleum, etc., applied to the afflicted parts will keep the flies away for several days; where sores are formed, add a little carbolic acid to the grease or oil; tobacco powder will kill the flies if it is dusted on them; spread out or mix lime with the fresh cow droppings; spray cows with crude petroleum. Also see repellant mixtures p. 120.

SUCKING CATTLE LICE² (*Hæmatopinus eurysternus*)
(*Hæmatopinus vituli*)

Order—Hemiptera

There are two species of sucking lice, the short-nosed ox louse and the long-nosed ox louse; they are apt to be

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 114.

²Osborn—U. S. Bu. Ent., Bull. 5, p. 172.

abundant especially on calves and on poorly cared for and ill-fed cattle; on these they may cause injury.

The eggs are attached to the hairs of the animal and the young lice gradually develop to the adults; life history not well known.

CONTROL—An infusion of stavesacre seeds seems to be the most accepted remedy. Four ounces stavesacre (Delphinium) seeds, 1 ounce white hellebore boiled in 1 gallon of water until only 2 quarts remain and applied with a brush where lice are seen; kerosene emulsion, 15%, or crude petroleum rubbed in among the hairs; 2 or 3 applications of either at an interval of one week.

THE BITING CATTLE LOUSE¹ (*Trichodectes scalaris*)

Order—Mallophaga

This species of louse is common the world over and is often very abundant; they do not seem to be as injurious as the sucking lice attributable to the fact, probably, that they do not suck blood; they are smaller than the sucking lice; they are generally found in more abundance in the spring of the year; at this time eggs and adults are easily found.

CONTROL—Same as for the sucking lice.

SOUTHERN CATTLE TICK² (*Boophilus annulatus*)

Order—Acarina

One of the ticks, thus not a true insect. It is the carrier of Texas fever, a blood disease caused by a minute protozoan parasite working in the red blood corpuscles; the ticks drop from the cattle when full grown and lay eggs, sometimes as many as 3,000 among the grass; the young ticks which hatch must find their way to the cattle to live, and these young ticks will introduce the disease to healthy stock; infested Southern cattle often introduce the disease into Northern herds, but as our cold winters kill the ticks, the disease disappears unless re-

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 209.

²Mohler—U. S. Bu. An. Ind., Bull. 78.

introduced in Southern ticks brought north the next season.

CONTROL—Thoroughbred Northern cattle are now taken south and there inoculated and only a mild form of the disease produced; a starving-out process, now being practiced by rotation of pastures or feed lots.

PESTS OF HORSES

BOT-FLY¹ (*Gastrophilus equi*)

Order—Diptera. Manual, p. 477

The adults are about three-fourths of an inch² long and rather light brown in color; the fly does not bite or sting yet many horses are much worried by its presence; authorities differ as to injury by the bots; they may irritate the stomach; may absorb much nutriment from the stomach contents, and may cause irritation in the intestines.

The fly attaches its eggs to the hairs on the legs and shoulders of horse; eggs licked off by horse and carried to stomach where the maggots or "bots" attach themselves to the walls of this organ; they usually spend six months in the digestive organs; probably not more than one maggot in fifty ever reach stomach; they live in the dung during May or June, go into ground and pupate.

CONTROL—Shave off the eggs with a sharp knife or razor once in two weeks at least; kill eggs by running over them lightly with kerosene or by dilute carbolic acid, one part acid to 30 parts water.

THE CHIN BOT-FLY (*Gastrophilus nasalis*)

Attaches its eggs to the hairs of the lips and nostrils and to the hairs of the throat.

CONTROL—Same as foregoing species.

HORSE-FLY OR GAD FLY² (*Tabanus atratus*)

Order—Diptera

A large black fly that flies swiftly, bites fiercely and is a persistent enemy of horses and cattle; eggs have been

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 76.

²Garman—Ken. Bull. 151.

found attached to leaves overhanging water; larvæ live in marshy ground and along streams; these flies often become abundant and injurious to cattle and horses but they do not produce "warbles" or bots.

CONTROL—Success has been obtained by putting kerosene oil on pools of water frequented by these flies. They are killed by coming in contact with the oil. Certain repellant mixtures may be put on cattle but difficult among large herds. Nets on horses are a protection.

A PEST OF HOGS

THE HOG LOUSE¹ (*Hæmatopinus urius*)

Order—Hemiptera

Occasionally this species appears in great numbers on swine; a full-grown louse measures one-fourth inch or more in length; it is gray in color and has sucking mouth-parts.

CONTROL—Washes of dilute carbolic acid (1 to 30) or the tobacco extracts or kerosene emulsion will control these lice; a wallowing trough of cement with a film of oil on top is a very good method of control.

OTHER INSECTS INJURIOUS TO LIVE STOCK

Turkey gnat (black-fly) (*Simulium meridionale*).

Buffalo gnat (black-fly) (*Simulium pecuarum*).

Brown gad-fly (*Tabanus exul*).

Ear-fly (*Chrysops vittatus*).

Stable fly (*Stomoxys calcitrans*).

Screw-worm fly (*Paralucilia macellaria*).

Lone star tick (*Amblyomma unipuncta*).

REPELLANTS FOR FLIES ON LIVE STOCK

Many mixtures have been recommended for application to horses and cattle to protect them from the attacks of flies. No one of these repellants has proved entirely satisfactory because of the trouble of application, the transitory effectiveness of the material, and the possi-

¹Osborn—U. S. Bu. Ent., Bull. 5, p. 178.

bility of injury to the animal to which the mixture has been applied.

The following mixtures are simple compounds and perhaps as effective as any in present use:

¹ Fish oil.....	100 parts
Oil of tar.....	50 "
Crude carbolic acid.....	1 part

Apply with hand spray pump or with a brush.

² Fish oil	1 gallon
Oil of tar	2 ounces
Oil of pennyroyal	2 ounces
Kerosene	½ pint

Apply lightly with a brush.

³ Crude cotton-seed oil	2 parts
Pine tar.....	1 part

Apply at milking time with a brush.

¹Moore—South Dakota Bull. 81, pp. 41-42.

²Bishop—U. S. Dept. Agri., Far's. Bull. 540.

³Weed—Miss. Bull. 28.

EXTERNAL PARASITES OF POULTRY

The external parasites of poultry are many in number, at least 18 different kinds of mites and 9 or 10 different kinds of lice are parasitic on poultry. One tick and two fleas are also found as pests on domestic fowls,

CHICKEN MITE¹ (*Dermanyssus gallinæ*)

Order—Acarina

The chicken mite can be found in almost any poultry house and often exceedingly abundant in some, especially unclean ones; it has a marked effect on egg production; will prevent hens from fattening and will drive sitting hens from nests; it causes a high mortality among young chicks and is a pernicious pest; the mouth parts are fitted for piercing and sucking and the mites suck the blood of their hosts; they are usually found on fowls only at night, for they remain hidden during the day in cracks and crevices of the perches and houses.

The mite varies in color from pale yellowish to red; it deposits small white eggs in cracks and crevices of the perches and nest boxes; these hatch in 3 or 4 days into almost white six-legged mites that gradually grow by casting their skins until they become adults with 8 legs; they increase enormously.

CONTROL—Poultry houses should be built so that every part of them is well lighted and aired; the houses should be kept scrupulously clean; the houses should be built so that the perches, nest boxes, etc., may be readily removed leaving only four bare walls; spray the inside of houses with one part crude carbolic acid and three parts kerosene; sitting hens should be isolated from laying hens; a dust bath should be provided for the fowls.

¹Herrick—Mississippi Bull. 78.

Repp—Iowa Bull. 69.

HEN LICE¹ (*Menopon pallidum* and other species)

Order—Mallophaga

There are 9 or 10 species of lice that infest fowls; they have biting mouth-parts and live upon scales of cast-off skin and on bits of feathers—do not suck blood; they irritate the fowls, however, by their presence and interfere with growth and egg production and are fatal to young chicks; these lice are permanent parasites and each leg ends in two sharp claws.

The lice deposit their whitish eggs or “nits” at the bases of the feathers; here they hatch and the young lice gradually grow into adults; life history not well known.

CONTROL—Use the same measures as for the mites; dips have been recommended but they are objectionable; one of the best is made by mixing 1½ ounces of pure carbolic acid with 1 gallon of hot water; when cool immerse the fowl in it one minute; creolin at the rate of 2½ ounces to the gallon may be used instead; the Cornell powder is good for dusting fowls; it is made of 1 part crude carbolic acid, 3 parts gasoline, and enough plaster of Paris to take up the liquid; ¼ pint of acid, ¾ pint of gasoline and about 2½ pounds of plaster will form about the right proportions. Apply the powder with a sifter or with the fingers and work it in among the feathers.

SCALY-LEG² (*Cnemidocoptes mutans*)

Order—Acarina

Scaly-leg among fowls is caused by a very small mite; the disease is contagious and fatal if not controlled; the legs become covered with hard greyish crusts, the fowl becomes lame and finally unable to walk when it will eventually die.

These minute mites live beneath the scales of the legs where a white powdery substance is formed which together with the serum forms the crust.

¹Theobald—Parasitic Diseases of Poultry.

²Theobald—Parasitic Diseases of Poultry.

CONTROL—The disease is contagious and the affected fowl must be isolated; disinfect house with hot water and carbolic acid and then whitewash it; soak leg of fowl in warm water for some minutes to soften the scales; then scrape them off carefully; coat with creosote 1 part and lard 20 parts or with Balsam of Peru once a day; the leg should be cleaned with hot water and soap.

DEPLUMING SCABIES¹ (*Cnemidocoptes gallinæ*)

Order—Acarina

Fowls often pluck out their own feathers or those of their mates; the feathers often fall out of themselves, that is, they break off at the bases; the bases of the quills become filled with a white powdery substance among which the mites live; here they set up an irritation that causes the fowl to pull out its own feathers; the disease usually commences at the rump and gradually spreads; the head and neck often become seriously affected; the mites are most abundant in spring and summer; as many as ten or twelve may be found at each feather.

CONTROL—The disease is contagious and the affected fowl should be isolated; dust the fowl with fresh Buhach; creosote and lard are also good; Theobald rubs oil of cloves over the affected area.

PULMONARY MITE² (*Cytodites nudus*)

Order—Acarina

These mites inhabit the bronchial tubes even reaching the cavities in the pneumatic bones; the mite is readily seen with the eye; it is only when they are abundant that they cause trouble; they sometimes occur in such numbers that they close up the tubes and produce asphyxia; this mite is of considerable size and readily seen with the naked eye; it is white and globular in form.

¹Theobald—Parasitic Diseases of Poultry.

²Theobald—Parasitic Diseases of Poultry.

HEN FLEA¹ (*Ceratophyllus gallinæ*)

Order—Siphonaptera

This hen flea is evidently not abundant in America having been found here but twice so far; it has sucking mouth parts and lives upon the blood of its host; fleas are not permanent parasites; they get on the hens to feed and when through leave them.

The female lays her white eggs in the nests chiefly, but sometimes on the floor among the droppings; the eggs hatch into long slender white worm-like larvæ that live on the organic matter found among the cracks and crevices of the house; in about two weeks they make a silken cocoon and change to the pupa; in two to three weeks the adults appear.

CONTROL—Same methods as advised for the control of the mites and lice.

THE CUBAN HEN FLEA² (*Echidnophaga gallinacea*)

Order—Siphonaptera

The flea occurs in the Southern States and at times becomes abundant and very irritating especially to sitting hens; they attach themselves to the face, to the wattles, comb, etc., and suck the blood; they finally drop off when mature and lay their eggs among the debris in the nest.

CONTROL—Same as for hen flea.

CHICKEN TICK (*Argas persicus*)

Order—Acarina

Occurs in Texas in injurious numbers.

¹Theobald—Parasitic Diseases of Poultry.

²Herrick—Jour. Ec. Ent., Vol. 1, p. 355.

CHICKEN OR FOWL-BUG (*Hæmatosiphon inodorus*).

Order—Hemiptera

This is a bug closely allied to the bedbug and it sometimes attacks sitting hens while on their nests.

CONTROL—Dust fowls with fresh Buhach.

COMMON BEDBUG (*Cimex lectularius*)

Order—Hemiptera

Sometimes a pest in poultry houses.

INSECTS INJURIOUS TO THE HOUSEHOLD

There are many insect pests that injure the foodstuffs, clothing, carpets, rugs, etc., of the household, and the aggregate loss caused by these insects is very large. Moreover, many of these pests are now known to be the disseminators of certain human diseases, so that they have become important from more than one point of view; the more important of these household pests are discussed in the following pages.

HOUSE-FLY (*Musca domestica*)

Order—Diptera. Manual p. 482

The house-fly lays its white eggs in manure, decaying vegetable material and other garbage; they hatch in 12 to 24 hours into the whitish maggots; the maggots reach maturity in 5 or 6 days and change to pupæ which are enclosed in dark-brown puparia; these rest quietly about 5 days and then the adult comes forth; the adults carry typhoid fever, cholera, tuberculosis, dysentery, and other enteric diseases.

CONTROL—Draw out stable manure once a week or put it in a dark closet; build a modern closet; screen whole house especially back porch; use tanglefoot paper and formaldehyde, 2 tablespoonfuls in a pint of water; use fresh Buhach.

MOSQUITOES (*Culex and Anopheles*).

Order—Diptera. Manual, p. 437

All mosquitoes lay their eggs on or in water or where water will eventually be; these (*Culex pipiens*) hatch into "wiggle tails" in 24 hours and the larvæ become mature in a week or ten days and in a few days more the adults appear; all mosquitoes differ some in their life history but in all it is passed in the water.

The *Anopheles* mosquitoes carry malaria thus causing much sickness and great financial loss.

CONTROL—Use oil on water; drain all pools of water; put fish in ponds that cannot be drained or oiled; screen houses; kill adults with Buhach; use bednets.

ANTS (several species)

Order—Hymenoptera. Manual, p. 633

The little red ant, the black carpenter ant, the pavement ant, and the small black ant, are the species most prevalent in houses in the North. In Louisiana, Mississippi, Texas and California, the Argentine ant is becoming a great and serious pest.

Some ants make their nests on the lawns, in the walls of the houses, etc., while others make them in old logs, decaying beams, and stumps, others under stones in the pavement, etc.

CONTROL—Isolate food products; use sponges soaked in sweetened water; locate nests and use carbon bisulphide; squirt kerosene in entrance holes and plug with cotton; use ant tape; use a mixture of tartar emetic 1 part, sugar 10 parts and water to moisten well.

CLOTHES MOTHS (three species)

Order—Lepidoptera. Manual p. 257

There are three species of these moths in the United States but only two are common in the North; the larvæ of these often do serious injury by eating holes in woolen garments and by damaging furs.

CONTROL—Air and shake clothes frequently; use moth balls; put woolens away in tight paper sacks; use a fumigation box.

CARPET BEETLES (two species)

Order—Coleoptera. Manual p. 539

There are two species of carpet beetles, the so-called "Buffalo bug" and the black carpet beetle; they deposit their eggs about the edges of the carpet where they are feeding; these hatch and the hairy larvæ feed upon the carpet.

CONTROL—Use rugs and finished floors; trap larvæ with woolen cloths; spray carpets with benzine, whip and hang in the sunlight; wash floors with strong soap-suds.

FLEAS (several species)

Order—Siphonaptera. Manual p. 490

There are two or three species of fleas that trouble household inmates, the human flea and the cat and dog fleas; the latter are the common ones and are the ones usually causing the trouble; the human flea is more or less common in California; the cat and dog fleas lay their white eggs while the flea is on its host but the eggs drop to the floor where they hatch into long worm-like larvæ; these larvæ live on the material found in the dirt along the cracks of the floor and about the baseboards; certain fleas disseminate disease, especially the plague.

CONTROL—Get rid of dog or cat or wash them often in a solution of creolin 4 teaspoonfuls to a quart of water for the dog, and 3 teaspoonfuls to a quart for the cat; use rugs and finished floors; wash floors with soapsuds and spray with benzine; use flake naphthaline.

COCKROACHES (several species)

Order—Orthoptera. Manual p. 106

There are four species that cause trouble in the United States; the croton bug, the oriental roach, the American roach, and the Australian roach; they lay their eggs in a mass in a sort of brown bean-like case; they live upon all kinds of food, but often contaminate with a roachy odor more than they eat; they injure books seriously at times.

CONTROL—Trap them; use Buhach; use borax; fumigate rooms with hydrocyanic acid gas; use insectoline.

BEDBUG (*Cimex lectularius*).

Order—Hemiptera. Manual p. 140

These insects go into houses in visitors' baggage, in laundry brought in from the washerwoman's; by migrat-

ing from another adjoining house; they lay their eggs in the cracks of beds and multiply in great numbers; they are suspected of carrying disease germs.

CONTROL—Use iron bedsteads; paint cracks in beds with gasoline, kerosene, or benzine; pour boiling water on the beds if not afraid of injuring varnish; fumigate with sulphur, 2 pounds to 1,000 cubic feet; fumigate with hydrocyanic acid gas.

Circ. 36, Clothes Moths. U. S. Dept. Agr. Bu. of Ent.

Circ. 71, Housefly. U. S. Dept. Agri. Bu. of Ent.

Circ. 108, House fleas. U. S. Dept. Agri. Bu. of Ent.

Circ. 5, Carpet Beetles. U. S. Dept. Agri., Bu. of Ent.

Circ. 34, Ants. U. S. Dept. Agri. Bu. of Ent.

Circ. 13, Mosquitoes. U. S. Dept. Agri. Bu. of Ent.

Bull. 4, Household Insects. U. S. Dept. Agri. Bu. of Ent.

Circ. 2, Farmers' Wives' Reading Course. Cornell.

Book, Insects Injurious to the Household and Annoying to Man, Glenn W. Herrick.

GENERAL PLAN FOR SPRAYING THE APPLE ORCHARD

I. Dormant season before leaf buds open but just as they are swelling:

- a. Lime-sulfur, 32° Beaumé, as a contact spray for
San José scale and oyster-shell scale, dilute concentrate 1-8
Blister mite, dilute concentrate 1-11.
- b. Add arsenate of lead, 2 lbs. to 50 gal., to the lime-sulfur as a poison for
Bud moth
Cigar case-bearer

II. After leaf buds open but before blossoms open, i. e., when just beginning to show some pink. Watch weather and get spray on *before* rain, not after:

- a. Lime-sulfur solution, 32° Beaumé 1-40, or bordeaux, 3-4-50, for apple scab (the fungus)
- b. Arsenate of lead, 2 to 3 lbs. to 50 gal., added to lime-sulfur or bordeaux as a poison for
Bud moth
Cigar case-bearer
Cankerworm

This application should never be omitted during cold, rainy seasons.

III. After petals have fallen, beginning when about two thirds have fallen. Have spray on *before* rains come. *This is important.*

- a. Lime-sulfur, 32° Beaumé 1-40, or bordeaux, 3-4-50, for
Apple scab
Leaf spot
- b. Arsenate of lead, 2 to 3 lbs. to 50 gal., used with lime-sulfur or bordeaux for
Codling moth
Cankerworm
Bud moth

This is the most important of all the applications.

IV. Ten days to two weeks later. *Before rain period:*

- a. Lime-sulfur, 32° Beaumé 1-40, or bordeaux, 3-4-50, for
Apple scab
Leaf spot
- b. Arsenate of lead, 2 to 3 lbs. to 50 gal., used with lime-sulfur or bordeaux for
Codling moth
Cankerworm

V. Eight to nine weeks after blossoms fall:

Same as IV for late scab infections and late attacks of codling moth. In most seasons this application is not necessary.

If aphid appears, spray before leaves curl with whale-oil soap, 1 lb. to 6 gal., or with kerosene emulsion diluted with 6 parts of water, or use one of the tobacco extracts.

GENERAL PLAN FOR SPRAYING THE PEACH ORCHARD*

I. Dormant season before the leaf buds begin to swell:

a. If scale is not to be combated, spray with lime-sulfur, 32° Beaumé, 1-15, or bordeaux, 4-4-50, or copper sulfate, 2 lbs. to 50 gal. water, for

Peach leaf-curl

Any of these will be effective if properly applied. Coat every bud, being sure to apply before buds have begun to swell at all.

b. Lime-sulfur, 32° Beaumé, 1-7 $\frac{3}{4}$, for

San José scale

This will also control peach leaf-curl.

II. About the time the calyxes, or shucks, are shedding from the young fruit:

a. Self-boiled lime-sulfur, 8-8-50, with arsenate of lead, 2 lbs. to 50 gal., for
Scab

Brown rot

As this is rather early for scab and rot, the self-boiled lime-sulfur may be omitted using merely

b. Arsenate of lead, 2 lbs. to 50 gal. of water, for

Curculio

If the self-boiled lime-sulfur is omitted, add to each 50 gal. water, milk of lime made by slaking 2 to 3 lbs. of good stone lime. This will tend to counteract any caustic action of the arsenate of lead.

III. Two or three weeks later, or about one month after petals fall:

a. Self-boiled lime-sulfur, 8-8-50, for

Scab

Brown rot

b. Add 2 lbs. arsenate of lead for

Curculio

IV. About one month before fruit ripens:

a. Self-boiled lime-sulfur, 8-8-50, for

Brown rot

b. Omit arsenate of lead.

*Taken from U. S. Dept. Agr., Bureau of Entomology Circular 120, pp. 6-7.

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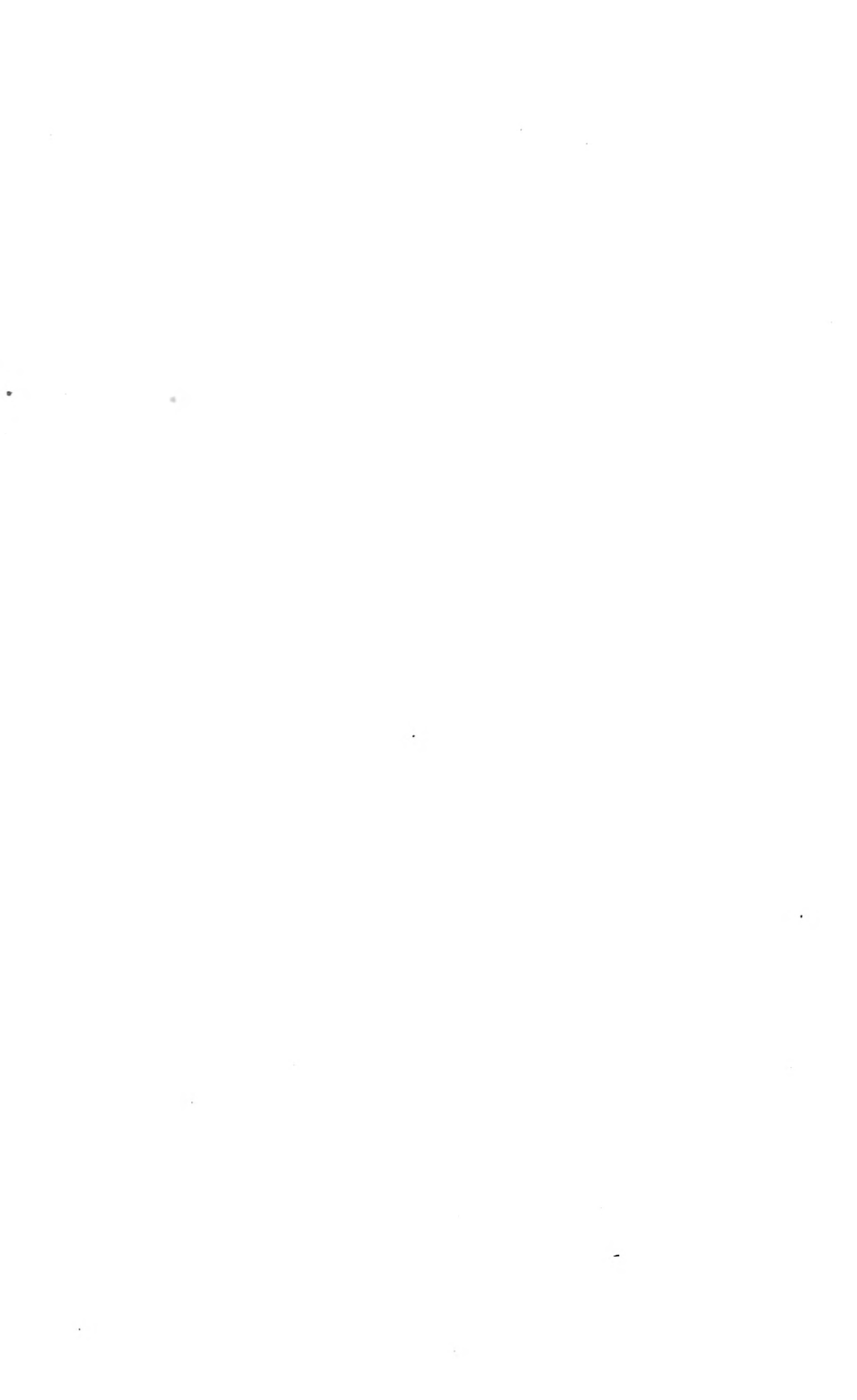
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